EDWARD JENNER, M.D.

THE DISCOVERER OF VACCINATION

Born, 1749 Died, 1823

The History of Inoculation

and

Vaccination

for the

Prevention and Treatment of Disease

Lecture Memoranda

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by

C. J. S Thompson

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"VACCINATION"

DR. JENNER PERFORMING HIS FIRST VACCINATION

From a bronze by GIULIO MONTEVERDE

The History of Inoculation and Vaccination

for the

Prevention and Treatment of Disease

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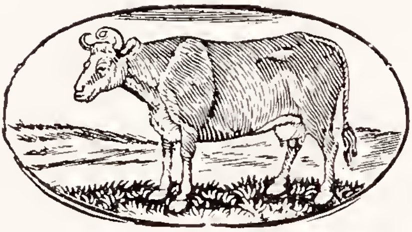

NOTE

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Beware! The Vaccine

The History of Inoculation and Vaccination for the Prevention and Treatment of Disease

CHAPTER I

The Practice of Inoculation in Antient Times

The practice of inoculation for the prevention of disease is one of considerable antiquity. The period of its discovery can only be conjectured, but there is little doubt that even in remote times it must have been recognised by man, that certain diseases occur once only during the life of an individual, or that after recovery he is generally immune against further attacks of the same disease. He also probably noticed that even a mild form of a complaint often conferred a certain protection against a further attack.

The antiquity of inoculation

The earliest attempts to utilise this protective act of Nature probably consisted in exposing children to the infection of some disease such as measles, in a mild form, in order to protect them against severer forms of the complaint in future. This custom was practised down to comparatively recent times.

Thus it is probable that a vague appreciation of the principles of immunity existed at a very early period. From this knowledge it was but a short step to the artificial production of certain diseases; especially when it was found, as in the case of smallpox, that a mild form of the complaint could be induced by the inoculation of the contents of a pustule into a healthy subject, and that such an inoculation was to some extent a safeguard against the possibility of contracting a severe attack of the disease.

First steps

From accounts recorded by explorers, there is evidence that inoculation in some form has been practised among savage tribes and barbaric peoples in various parts of the world, from an unknown period. It is probable that the custom had its birth in India and the Far East, and thence spread westward to Africa and Europe.

Colonel Serpa Pinto, the Portuguese traveller, found in 1877 that certain races in North-east Africa practised a form of inoculation against the bites of poisonous snakes. He states that they mix the venom of serpents with certain vegetable juices, and rub the brown paste so formed into incisions in the skin of the arm. He was thus inoculated himself, and states that the operation was followed by pain and swelling, but it seemed to be effective and to produce an immunity to certain poisons, as he was afterwards bitten by a venomous snake without any after-effects.

Inoculation against snake poisoning

The bush negroes in Surinam also are said to practise a similar method of inoculation to protect themselves against the bites of poisonous snakes.

Bruce, in his "Voyage to the Sources of the Nile," 1790, says he found that inoculation as a protection against smallpox had been practised in Nubia from time immemorial by the negresses, the Arab women, Nubians, Shillooks, and other native tribes. The operation was called by them "*tishjerée*" and "*tidderé*," or, as among other African nations, "buying the smallpox." The method was by contact. A woman would bind a piece of cotton material round the arm of someone suffering from smallpox, which, when impregnated with the virus, she would apply to the arm of her child. Bruce states that "nobody was known either in Sennaar or Abyssinia who had had smallpox more than once."

"Buying the smallpox"

Inoculation as a preventive of smallpox was known to the Ashantees, and Bowditch states that a method

of inoculation has been known and practised among the Moorish and Arab tribes in Northern Africa from antient times, to protect them from smallpox. They inoculate their patients both on the arms and legs in seven distinct places, thus using a mystic number.

Among some of the savage tribes that inhabit the regions of the Upper Congo, travellers state that a method of inoculation to prevent syphilis is practised by the natives.

Inoculation for smallpox and venereal diseases

Felkin, in his "Travels among the Baris of Lado," 1882, says that "smallpox is often very prevalent in these districts, and also venereal diseases. At one time they were so bad that inoculation was practised, and this has since become the general law. It is performed over the left breast, and the natives say they believe the disease will be stamped out in time, so much good has resulted from the practice. It is a noteworthy fact that they have discovered this method, for after many enquiries I am quite certain it has not been introduced from foreign sources."

In other parts of Africa, also, explorers have recorded that they found inoculation known to, and practised by, the natives. Among the negroes in Senegal the practice of inoculating children on the arm against smallpox was a common one. After the operation they were made to abstain from animal food, and were allowed to drink freely of water acidulated with lime juice.

Pleuro-pneumonia in cattle

De Rochebrune relates that the Moors and Pouls of Senegambia have for ages inoculated their cattle against pleuro-pneumonia. "The point of a knife or dagger of primitive form is plunged into the lung of an animal that has died of the disease, and an incision, sufficient to allow the virus to penetrate below the skin of the healthy animal, is made into the supra-nasal region."

A MALABA WOMAN INVOKING THE GODDESS OF SMALLPOX AND CARRYING FIRE ON HER HEAD SYMBOLIC OF THE DISEASE

From a native drawing

It is stated that at Berne, in Switzerland, in the eighteenth century a similar form of inoculation against pleuro-pneumonia was practised.

Boer methods

According to Sternberg, the natives on the banks of the Zambesi cause animals afflicted with pleuro-pneumonia to swallow a certain quantity of the liquid from the pleural cavity of an animal recently dead. The method, however, which is employed most extensively, is that said to have been discovered by the Boers. This consists in inoculating animals in the tail, by means of a syringe or worsted thread, with serum from the lungs of an animal recently dead, or with virus obtained from the tumefaction produced by such an inoculation in the tail.

From evidence that has been gathered from various parts of the world, the practice of inoculation appears to have originated with smallpox, a disease of which the early history is somewhat obscure. It may be interesting, therefore, to recapitulate briefly what is known of its origin.

The origin of smallpox and inoculation

The antiquity of the disease in the Far East appears to be without doubt, but the documentary records concerning its first appearance are shadowy and uncertain. According to tradition, smallpox appears to have had its origin in India, where inoculation is said to have been practised over a thousand years before the Christian era.

Dhanwantari, the Vedic father of medicine, and the earliest known Hindu physician, who is supposed to have lived about 1500 B.C., is said to have been the first to have practised inoculation for smallpox. It is even stated that the antient Hindus employed a vaccine, which they prepared by transmission of the smallpox virus through the cow. King quotes the following, which is stated to be translated from the writings of Dhanwantari :—

"Take the fluid of the pock on the udder of the cow or on the arm between the shoulder and elbow of a human subject on the point of a lancet, and lance with it the arms between the shoulders and elbows until the blood appears. Then, mixing this fluid with the blood, the fever of the smallpox will be produced."

Lord Ampthill, Governor of Madras, at the opening of the King Institute in February, 1905, said: "Colonel King gives clear proof that the antient caste injunctions of the Hindus were based on a belief in the existence of transmissible agents of disease, and that both Hindus and Mohammedans used inoculation by smallpox virus as a protection against smallpox; and certain it is that long before Jenner's great discovery, or, to be more correct, re-discovery of vaccination, this art of inoculation was used for a while in Europe, where it had been imported from Constantinople, and the knowledge of medicine which flourished in the Near East at the commencement of the Christian era, emanated, as I have already shown you, from India. It is also very probable, so Colonel King assures me, that the antient Hindus used animal vaccination, secured by transmission of the smallpox virus through the cow, and he bases this interesting theory on a quotation from a writing by Dhanwantari, the greatest of the antient Hindu physicians."

Holwell, writing in 1757, gives some interesting details as to the method of inoculation employed by the Hindus. He states: "It is performed in Indostan by a particular tribe of Brahmins, who are delegated annually for this service from the different colleges scattered throughout the distant provinces. Dividing themselves into small parties of three or four, they plan their travelling circuit in such a way as to arrive at the places of their expected destination some weeks before the usual return of the disease; they arrive commonly in the Bengal provinces early in February, although in some years they do not begin inoculation before

Brahmin inoculators

March, deferring it until they have considered the state of the season, and acquired information of the state of the distemper.

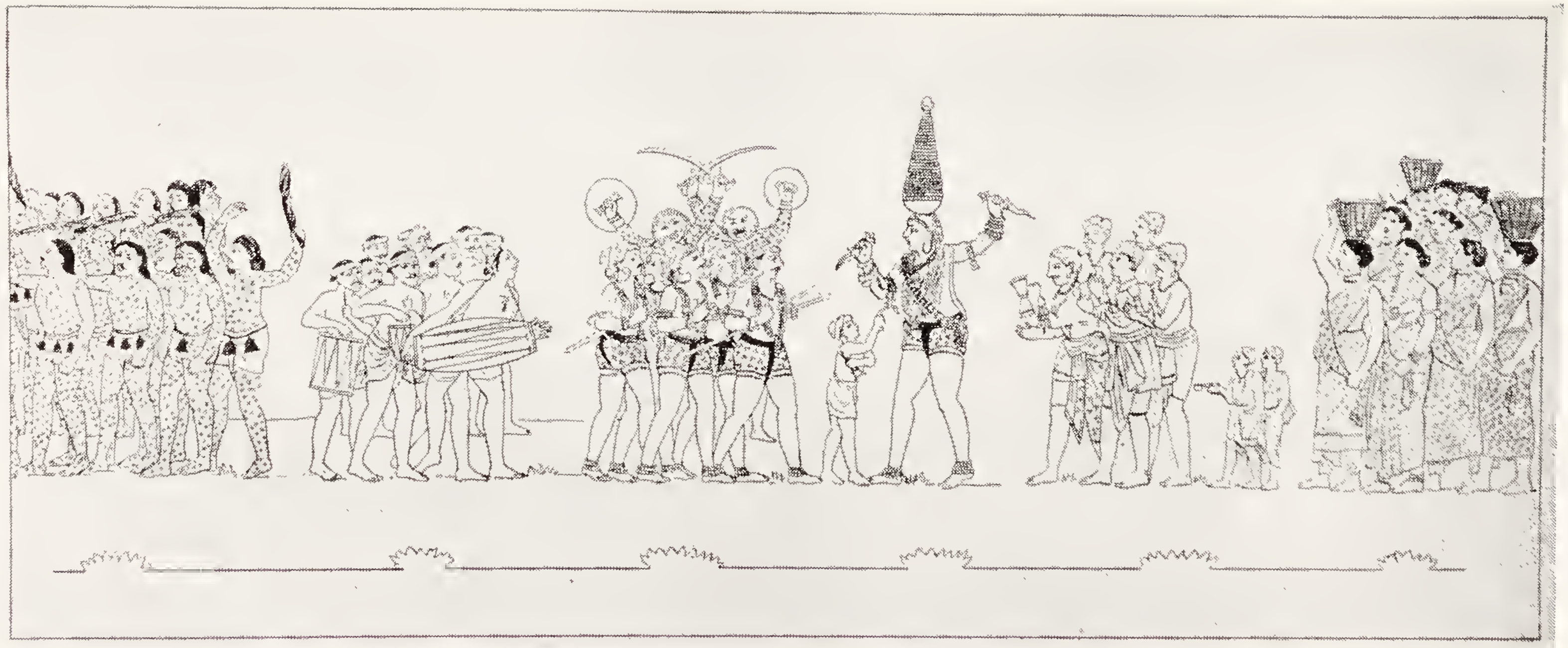
"The inhabitants of Bengal, knowing the usual time when the inoculating Brahmins annually return, observe strictly the regimen enjoined, whether they determine to be inoculated or not; this preparation consists only in abstaining for a month from fish, milk, and ghee (a kind of butter made generally of buffalo's milk); the prohibition of fish refers only to the native Portuguese and Mohammedans who abound in every province of the empire. When the Brahmins begin to inoculate, they pass from house to house and operate at the door, refusing to inoculate any who have not, on a strict scrutiny, duly observed the preparatory course enjoined them.

Dietetic regimen preparatory to inoculation

"It is no uncommon thing for them to ask the parents how many pocks they chuse their children should have. Vanity, we should think, urged a question on a matter seemingly so uncertain in the issue; but true it is that they hardly ever exceed or are deficient in the number required.

"They inoculate indifferently on any part; but, if left to their choice, they prefer the outside of the arm, midway between the wrist and the elbow for the males; and the same between the elbow and the shoulder for the females. Previous to the operation, the operator takes a piece of cloth in his hand (which becomes his perquisite if the family is opulcnt), and with it gives a dry friction upon the part intended for inoculation for the space of eight or ten minutes, about the compass of a silver groat, just making the smallest appearance of blood; then opening a linen double rag (which he always keeps in a cloth round his waist), he takes from thence a small pledget of cotton charged with the variolous matter, which he moistens with two or three drops of the Ganges

Method of inoculation



A Religious Dramatic Representation of the Power of the Hindoo Goddess of Smallpox

From an Antient Oriental Drawing

The goddess stands with two uplifted crooked daggers, threatening to strike on the right and left. Before her is a band of the executors of her vengeance. Two of them wear grinning red masks, carry black shields, and brandish naked scimitars. White lines, like rays, issue from the bodies of the others, to indicate infection. On the left there is a group of men with spotted bodies, inflicted with the malady; bells are hung at their cinctures, and a few of them wave in their hands black feathers. They are preceded by musicians with drums, who are supplicating the pity of the furious deity. Behind the goddess, on the right, there advances a bevy of smiling young women, who are carrying gracefully on their heads baskets with thanksgiving offerings, in gratitude for their lives and their beauty having been spared. There is, besides, a little boy with a bell at his girdle, who seems to be conveying something from the right arm of the goddess. This action may probably be emblematic of inoculation. In a country where every thought, word and deed are mere repetitions of those of their progenitors, a composition like this bears the stamp of great antiquity. (Moore.)

water, and applies it to the wound, fixing it on with a slight bandage, and ordering it to remain on for six hours without being moved; then the bandage to be taken off, and the pledget to remain until it falls off itself." (During the time this operation lasts, he does not cease to repeat certain passages from a sacred book, stated by the Brahmins to be three thousand, three hundred and sixty-seven years old.)

"The cotton, which he preserves in a double calico rag, is saturated with matter from the inoculated pustules of the preceding year; for they never inoculate with fresh matter, nor with matter from the disease caught in the natural way, however distinct and mild the species . . . . Early on the morning succeeding the operation, four collons (an earthen pot containing about two gallons) of cold water are ordered to be thrown over the patient, from the head downwards, and to be repeated every morning and evening until the fever comes on (which usually is about the close of the sixth day from the inoculation), then to desist until the appearance of the eruptions (which commonly happens at the close of the third complete day from the commencement of the fever), and then to pursue the cold bathing as before through the course of the disease, and until the scabs of the pustules drop off. They are ordered to open all the pustules with a fine sharp-pointed thorn as soon as they begin to change their colour, and whilst the matter continues in a fluid state. Confinement to the house is absolutely forbidden, and the inoculated are ordered to be exposed to every air that blows, and the utmost indulgence they are allowed when the fever comes on, is to be laid upon a mat at the door; but, in fact, the eruptive fever is generally so inconsiderable and trifling as very seldom to require this indulgence. Their regimen is ordered to consist of plantains, sugar-canes, water-melons, rice, gruel made of white poppy-seeds and cold water, or thin rice gruel for their ordinary drink. These instructions being given, and an injunction laid on the patients to make a thanksgiving, Poojah, or offering to the goddess on

their recovery, the operator takes his fee, which from the poor is a *pund of cowries*, equal to about a penny sterling, and goes on to another door down one side of the street, and up on the other; and is thus employed from morning to night, inoculating sometimes eight or ten in a house."

Inoculation in China

Although it is said by some that the practice was introduced from India about 200 B.C., China has often been referred to as being the birthplace of inoculation. This, however, is now disputed, and doubt is cast upon it, owing to difficulty in identifying the ideograph or Chinese written character signifying the name of the disease. Recent investigators are of the opinion that the word "smallpox" in China does not date earlier than the fourteenth century. There is a reference, however, in an antient Chinese work to an ambassador to the Court in A.D. 561, of whom it is said "he had just passed through the feverish disease, and his face was covered with scars," but this may or may not have been smallpox. In the year 1631, it was stated by Wylie that "smallpox has engaged the attention of the Chinese from near the commencement of the Christian era, and inoculation has been practised among them for a thousand years or more." He bases this statement, apparently, on a Chinese treatise on pock spots, said to have been published in 1323 and republished in 1542, but we have not been able to trace this work for verification.

In 1626

The most reliable evidence of the antiquity of the practice of inoculation in China is that given by François Xavier d'Entrecolles, who was a Jesuit missionary in China in the seventeenth century. He states definitely, in a letter written from Peking in May, 1726, that the practice was known in China for a century before that date, and quotes an extract from the works of a Chinese physician who lived in the Ming dynasty, *ca.* 1626, who mentions the practice, but says that as everyone

must necessarily have smallpox once in their lives, it was better to let it be contracted naturally.

D'Entrecolles states, concerning the Chinese phrase for smallpox inoculation, "*tchung-teou*," meaning "*tchung*" to sow, "*teou*" smallpox, that the latter word also means "eating peas," and that the Chinese probably gave this name to smallpox on account of the similarity of the pustules to peas.

The Chinese method in 1726

According to a recipe given to the missionary by a Court physician in 1726, the Chinese placed the dried matter of the smallpox pustule in a vase, which they very carefully sealed. They stated that "if kept in this way, the matter would retain its virulence for several years, but that if the vase had the smallest opening it lost its virulence in twenty days. The method of inoculation was to take four scales, if small, or two, if large, and place musk between them, a little more than a grain in weight; place all in a piece of cotton, and insert in the nostril. In the case of a boy, place in the right nostril, and of a girl, in the left. The smallpox virus must be taken from young children, between the ages of one and seven."

If it were necessary to resort to the use of recent pustules, they were exposed to the steam of an infusion of the herb scorzonera and liquorice, in order to correct "the acrimony of the matter." Sometimes they used scales, previously dried and powdered, then made into a paste, the whole being wrapped up in cotton wool, and introduced into the patient's nostrils. This often set up a troublesome inflammation, and even if this did not take place, the inhalation into the lungs often produced the disease itself.

D'Entrecolles further states that the Emperor of China sent physicians from Peking, in 1724, to Tartary, the inhabitants of which country were suffering from an epidemic of smallpox, in order to inoculate the children against the disease. We are assured that the operations they performed were successful, a fact which seems to be corroborated by the statement

FIGURES SHOWING VACCINATION PUSTULES

From a Chinese work on Vaccination

that the physicians returned to Peking laden with presents of horses, skins, etc., presented to them by the Tartars in payment for their services.

Kirkpatrick, who also describes the Chinese method of inoculation, gives a slightly different account. He states that, instead of using the dried scales, a small piece of cotton was dipped into the fresh and fluid matter of the pustules, and immediately introduced into the nose. Apparently, therefore, the Chinese employed both the dried and fluid variolous matter, but the method of introduction through the nose appears to be peculiar to the Chinese.

Another account

In Tibet, inoculation is said to have been practised from antient times, the method employed being to dip a bundle of needles in a solution of the pock virus and the dried crusts in water, and then to prick the arm with the same.

In Siam a method of inoculation similar to that employed in China, whence it was probably introduced, is practised. The pus is taken from the pustules, and blown into the nostrils, and this is claimed to protect the individual thus inoculated against an attack of the disease.

The actual period of the first outbreak of smallpox in Europe was probably about the latter part of the sixth century. It appears to have travelled west through Arabia, Ethiopia and the neighbouring countries, and was brought by the Arabs into Egypt. It was apparently unknown to the Greeks and Romans, and, according to antient historians, does not appear to have attacked civilised nations engaged in commerce or wars in foreign countries, before the latter end of the sixth, or the beginning of the seventh, century.

First outbreak of smallpox in Europe

The earliest definite statements concerning the disease come to us from Arabia, and, according to an Arab manuscript in the library at Leyden, the first

record of smallpox dates from A.D. 572, the year of Mohammed's birth. From the following passages in the Chronicle of Bishop Marius, who died in A.D. 590, it might, however, be inferred that smallpox dates from a slightly earlier period than that indicated in the Leyden manuscript:—

"In 570 a powerful scourge with flow from the abdomen and pox spread extensively over Italy and France; and oxen in the mentioned countries were . . . ."

"In 571 an abominable infirmity and glanders, which is its name, and pustules, killed innumerable people in the above-mentioned countries."

There is further evidence of its appearance among the Abyssinian army of Abraha, at the siege of Mecca, in what was known as the Elephant War of A.D. 569 or 571.

Referring to this, Tabari, one of the most reliable of the Arab historians, states: "It has been told to us by Ibn Humaid, after Salima, after Ibn Ischâg, to whom Ja'gûb b. Otha b. Mughira b. Achnas related that one had said to him, that in that year the smallpoc appeared for the first time in Arabia, and also the bitter herbs, rue, colocynth (and another)."

He then proceeds to relate the following interesting legend as to the cause of the disease:—

"Thereupon came the birds from the sea in flocks, every one with three stones, in the claws two and in the beak one, and threw the stones upon them. Wherever one of these stones struck, there arose an evil wound, and pustules all over. At that time the smallpox first appeared and the bitter trees. The stones undid them wholly. Thereafter God sent a torrent which carried them away and swept them into the sea. But Abraha and the remnant of his men fled; he himself lost one limb after another."

In a former passage the calamity of Abraha is thus described: "But Abraha was smitten with a heavy

stroke; as they brought him along in the retreat his limbs fell off piece by piece, and as often as a piece fell off, matter and blood came forth."

To illustrate this account by Tabari, his recent editor, Nöldeke, cites the following from an anti-Mohammedan poem: "Sixty thousand returned not to their homes, nor did their sick continue in life after their return." One of the elephants that dared to enter the sacred region is said to have been also wounded and afflicted by the smallpox.

"In this narrative of Abraha's disaster," says Nöldeke, "there is a mixture of natural causation and of purely fabulous miracle; a real and sufficient account of the Abyssinian leader's discomfiture, namely an outbreak of smallpox, had been blended with legendary tales. That the disease was smallpox is made probable by the continuity of the Arabic name. Rhazes, under the same name, later described the symptoms, pathology and treatment of what was unquestionably the smallpox afterwards familiar in Western Europe."

It is stated by another historian that smallpox broke out on the sacking of Alexandria by the Arabs in A.D. 640; thence it spread, by means of the pilgrims and commerce, through Egypt, Palestine, Syria and Persia, and is said to have broken out along the coast of North Africa. In the commencement of the eighth century it was known in Mauretania, and thence crossed the Mediterranean into Italy. It was also about this period that the Arabs and Moors introduced it into Spain, when they established themselves at Cordova. Afterwards it passed to Portugal, Navarre, Languedoc and Guienne, whence it was carried into Western and Northern Europe.

The earliest physician to describe smallpox was Ahrun, an Egyptian by birth, and a Christian priest, who lived at Alexandria under Heraclius (A.D. 610–641). He wrote a work on physic in thirty books, now lost, entitled "Pandectae Medicinae," in which he is said to have described the symptoms of smallpox and its

eruption, and to have distinguished the milder from the dangerous variety. This work, originally written in Greek, was translated into Syriac by Gosius, about A.D. 680, and Maserjawaih, a Jewish physician of Bassora, translated it into Arabic, about A.D. 683, with the addition of some observations of his own as to the treatment of diseases of the eyes proceeding from smallpox.

The next to notice the disease was George, physician to Almangar, who was a great patron of learning. In a work written about A.D. 795 he describes smallpox and its symptoms.

The effects of smallpox are also noticed by John, a son of Mesue, a Syrian by birth, who was connected with the medical school of Baghdad, formed under the protection of Haroun Al Raschid, to whom he was physician. He advises, in his course of treatment, that "the body, if necessary, should be kept open until the seventh day."

Isaac Johannitius is the next physician to allude to smallpox. He recommends bleeding, and observes that the body should be restrained for three weeks.

The first complete treatise on the disease was written by Rhazes, about A.D. 920; originally written in Syriac, this work was translated into Greek and then into Latin.

Smallpox in Syriac was termed "chaspe," which was translated into Greek as Επφλογόῶ. The Latin translator first termed it "Incendium." The word "variolæ" is derived from the Hebrew בדפ, meaning a spot or speck. Hence the Latin "varus" or "variola," the Italian "vajolo," the French "vérole," and the English "smallpox."

Rhazes describes the signs, characteristic symptoms and remedies for the disease, but the latter he borrows chiefly from his predecessor Ahrun.

The first allusion to smallpox in England is that made in the Anglo-Saxon manuscript, "Medicinale

Anglicum," which is said to have been written in the early part of the tenth century. In one of the leechdoms there is an allusion to the "pockes," the plural of a word which signifies "a pustule." On the appearance of the disease, bleeding is recommended, to be followed by the following treatment:—

"Against pockes: very much shall one let blood, and drink a bowlful of melted butter; if they (the pustules) strike out, one shall dig each with a thorn, and then drop one-year alder-drink in, then they will not be seen."

This last instruction, evidently intended to prevent pitting, clearly identifies the disease.

In Egypt, inoculation for smallpox is said to have been practised in the thirteenth century. Matty states that the Mamelukes introduced it at the time of the Crusades, and the conquering Arabs carried it to other parts of Africa, especially to the countries bordering the Red Sea. The slave merchants who brought the Mamelukes to Alexandria, whence they were taken to Cairo and sold to Saladin, probably played their part in spreading the knowledge of inoculation in the south of Egypt and adjacent countries. The method, however, is said not to have been largely favoured by strict Mohammedans.

A further allusion in early English medical literature to smallpox is made by John of Gaddesdon in the "Rosa Anglica," which was written between 1305 and 1314. He devotes a chapter to "De variolis (et morbilis)," but this does not appear to possess much originality, and is distinctly borrowed from the early Arab writers.

Sydenham was the first great English physician to make a study of the disease, and he advised the use of bleeding, and directed that the patient should be taken out of bed and exposed to the cool air of his room during the time the fever is at its highest.

Dr. Thomas Dimsdale
(Afterwards Baron Dimsdale)

Born 1712 Died 1800

CHAPTER II

Smallpox Inoculation in Europe from the Seventeenth to the Eighteenth Century

From Asia and Africa the practice of smallpox inoculation passed into Europe by way of Greece and the coasts of the Bosphorus to Constantinople, where it was known at the latter part of the seventeenth century.

In 1701, when a serious epidemic of the disease broke out in that city, Timoni and Pylarini, two medical men who were there at the time, and who were aware of the practice, recommended the employment of inoculation.

Timoni first saw inoculation practised in Constantinople by two women, and describes the operation in detail.

Inoculation by women in Constantinople

"The Circassians, Georgians and other Asiaticks," he states, "have introduced this practice of procuring the smallpox by a sort of inoculation for about the space of forty years, among the Turks and others at Constantinople. They that have this inoculation practised upon them are subject to very slight symptoms, some being scarce sensible that they are ill or sick. The method of the operation is thus: Choice being made of a proper contagion, the matter of the pustules is to be communicated to the person proposed to take the infection, whence it has metaphorically the name of insition or inoculation.

"For this purpose they make choice of some boy or young lad, of a sound healthy temperament, that is seized with the common smallpox (of the distinct, not flux sort), on the twelfth or thirteenth day from the beginning of his sickness; they, with a needle, prick the tubercles (chiefly those on the shins and hands), and press out the matter coming from them into some convenient vessel or glass, or the like, to receive it. It is convenient to wash and clean the vessel first

with warm water. A convenient quantity of this matter being thus collected is to be stopped close and kept warm in the bosom of the person that carries it, and as soon as may be brought to the place of the future expecting patient. The patient, therefore, being in a warm chamber, the operator is to make several little wounds with a needle in one, two or more places of the skin until some drops of blood follow, and immediately drop out some drops of the matter in the glass and mix it well with the blood issuing out; one drop of the matter is sufficient for each place prick'd. These punctures are made indifferently in any of the fleshy parts, but succeed best in the muscles of the arm or radius. The needle is to be a three-edg'd surgeon's needle; it may likewise be performed with a lancet. The custom is to run the needle transverse and rip up the skin a little, that there may be a convenient dividing of the part, and the mixing of the matter with the blood more easily perform'd; which is done either with a blunt stile or an ear-picker. The wound is covered with a half a walnut shell or the like concave vessel and bound over, that the matter may not be rubb'd off by the garments, which is all removed in a few hours. The patient is to take care of his diet. In this place the custom is to abstain wholly from flesh and broth for twenty or twenty-five days. This operation is performed either in the beginning of the winter or in the spring."

Their method described

Another method was described by Pylarini shortly afterwards, which he saw practised in Turkey by an old woman on the four sons of a Greek nobleman. It consisted in inserting the variolous matter into a number of punctures made on the forehead, cheeks, chin and wrist.

As stated by Timoni, the practice of inoculation for smallpox was introduced into Turkey from Circassia, where it was said to have been employed for a considerable period previously.

The Danes appear to have practised inoculation against smallpox from the seventeenth century, and, according to Bartholin, writing in Copenhagen, in 1673, "the practice was a common one in Denmark." In 1758, two inoculation houses were established by the King in the capital, and, in 1760, one of the royal princes was inoculated, with success.

In Denmark

In 1711, De La Motraye says that he saw the operation performed on a Circassian girl, four or five years old. The girl after being purged with dried fruits, was carried to a boy about three years old, who had caught the natural smallpox, and whose pocks were *ripe*. An old woman performed the operation; for women of advanced age exercised the practice of physic in Circassia. The manner of inoculating the disease he describes as follows:—

"She took three needles fastened together, and prick'd first the pit of the stomach; secondly, directly over the heart; thirdly, the navel; fourthly, the right wrist; and, fifthly, the ankle of the left foot, till the blood came. At the same time, she took some matter from the pocks of the sick person, and applied it to the bleeding part, which she covered, first with *angelica* leaves dri'd, and after with some of the youngest lamb-skins; and having bound them all well on, the mother wrapped her daughter up in one of the skin coverings, which, I have observed, compose the Circassian beds, and carried her thus packed up in her arms to her own home; where (as they told me) she was to continue to be kept warm, eat only a sort of pap made of cummin flower, with two-thirds water and one-third sheep's milk, without either flesh or fish, and drink a sort of tisan, made with *angelica*, *bugloss* roots and *licorish*, which are all very common throughout this country, and they assured me that with this precaution and *regimen*, the smallpox generally came out very favourably in five or six days."

The Circassian method

Kennedy, an English surgeon, in an essay on external remedies, written in 1715, describes the method of ingrafting the smallpox, as practised in the Peloponnesus, now called the Morea, which he states "at this present time is very much used both in Turkey and in Persia, where they give it in order to prevent its more dismal effects by the early knowledge of its coming, as also probably to prevent their being troubled with it a second time.

"The Persians use the pock and matter dried into powder, which they take inwardly, but in Turkey, more particularly in Constantinople, they first take a fresh and kindly pock from someone ill of this distemper, and having made scarifications upon the forehead, wrists and legs, or extremities, the matter of the pock is laid upon the foresaid incision, being bound on there for eight or ten days together; at the end of which time, the usual symptoms begin to appear, and the distemper comes forward as if naturally taken ill, though in a more kindly manner and not near the number of pox. During this time, or from the scarifications being made, the patient is closely confined to his room, so as in no way to be exposed to the air; and the regimen or diet during the whole time of confinement is altogether from flesh, and one kept mostly to water-gruel. By this very regular way of living the distemper, or pock, comes out more kindly and less dangerous, since it is very probable that most of the malignity is increased and augmented by the irregularities committed in their diet or their manner of living some few days before the malady appears—which, when it comes naturally, cannot be so well seen or known how to prevent its worst symptoms, so as when given after this manner."

Persian and Turkish methods compared

In 1726, Dr. Russell, a physician then residing in Aleppo, records the fact that he met with an old Bedouin servant, who was familiar with the practice of inoculation. This, she asserted, was done with a

needle, and she herself had received the disease in that manner when a child. She informed Dr. Russell the practice was well known to the Arabs, and that they termed it "buying the smallpox." On prosecuting further enquiries into the subject, Russell found that the practice of inoculation had been one of long standing among the Arabs, and even those over seventy years of age remembered to have heard of the custom among their ancestors.

Known to the Arabs

Their method of operating was to make several punctures in some fleshy part with a needle which had been charged with variolous matter taken from a favourable kind of pock. They used no preparatory treatment, and the disease communicated in this way, they affirmed, was always slight. The origin of the term "buying the smallpox," is somewhat curious, and it is said to have taken rise from the following ceremony:—

"The child to be inoculated carries a few raisins, dates, sugar plums, or such like; and showing them to the child from whom the matter is to be taken, asks how many pocks he will give in exchange. The bargain being made, they proceed to the operation. When the parties are too young to speak for themselves, the bargain is made by the mothers. This ceremony, which is still practised, points out a reason for the name given to inoculation by the Arabs; but by what I could learn among the women, it is not regarded as indispensably necessary to the success of the operation, and is, in fact, often omitted."

The Arabian method

The same custom was found to prevail among the Eastern Arabs, not only at Baghdad and Mousul, but in Bassora. At Mousul the appearance of smallpox was announced by the public crier, so that those who wished might have their children inoculated.

Various races appear to have inoculated in different parts of the body. Thus the Arabs usually chose the

hand, between the thumb and first finger, the Georgians the forearm, and the Armenians both thighs.

In Armenia

In Armenia the Turkoman tribe, as well as the Armenian Christians, are said to have practised inoculation for a period beyond the memory of man, but they are unable to give any account of its first introduction among them. Along the coast of Syria and Palestine, and also at Damascus, inoculation has long been practised, and in the Castravan mountains it is known to, and employed by, the Drusi as well as the Christians.

Tripoli, Tunis, Algiers

In Tripoli, Tunis and Algiers, the practice of inoculation was described by Cassim Aga, ambassador in England in 1728. He states that the method employed by those who wished to have their children inoculated was to carry them to one that was afflicted with the smallpox at the time when the pustules had come to full maturity. "Then the surgeon makes an incision on the back of the hand, between the thumb and forefinger, and puts a little of the matter, squeezed out of one of the largest and fullest pustules, into the wound. This done, the child's hand is wrapped up in a handkerchief to keep it from the air, and he is left to his liberty till the fever arising confines him to his bed, which commonly happens at the end of three or four days. After that, by God's permission, a few pustules of the smallpox break out upon the child. All this I can confirm by the domestic proof, for my father carried four brothers and three sisters to the house of a girl that lay ill of the smallpox, and had us all inoculated the same day." He concludes by stating that "this practice is withall so antient in the kingdoms of Tripoli, Tunis and Algiers, that nobody remembers its first rise, and it is practised generally, not only by the inhabitants of the towns, but also by the wild Arabs."

In Western Europe, according to Schwenk, inoculation was practised in Meurs, in France, and also in

Cleves, as early as 1712. In 1707, Boyer records that it was known to the peasants in Auvergne and Perigord. In 1752, attention was again called to the matter, by Butini of Montpelier, and by De La Condamine. Three years later, Tergot inoculated a child four years of age, and one M. Chastellux, aged twenty-four, also submitted to the operation.

In Western Europe

A serious and fatal outbreak of smallpox in Paris in 1763 was attributed partly to inoculation, with the result that the practice was prohibited by the Government. But, five years later, on the recommendation of the medical faculties, this decree was rescinded, and during the latter part of the eighteenth century it was again commonly practised in Paris.

A curious sidelight which shows how the burning questions of the time are reflected even on the fashions of the day, is related in the life of the famous Mlle. Rose Bertin, who was milliner to Marie Antoinette. Mlle. Bertin owed her European reputation to her taste and the ingenuity with which she utilised current events to vary her fashionable designs. In the latter part of the eighteenth century the elaborate coiffeurs affected by ladies of the period were of the most extraordinary description. One of these, known as the "pouf á l'Inoculation," was introduced by Mlle. Rose Bertin to coincide with the inoculation of the young king, Louis XVI, which took place on June 18, 1774. For some time after this interesting event every lady who wished to be in the fashion wore in her hair a miniature model of the rising sun, and a heavily laden olive tree, round whose trunk was entwined a serpent, supporting a club, wreathed with flowers. This device was supposed to symbolise the power of medicine, represented by the snake, to overcome the horrors of smallpox; the rising sun was supposed to symbolise the royal patient, who was a descendant of "le roi soleil," while the olive tree represented the peace and joy of his loving subjects at the successful issue of the operation.

Mlle. Rose Bertin

In Germany, inoculation appears to have been first introduced by Maitland in 1724, who journeyed to Hanover to operate on Prince Frederick of Prussia, and afterwards on the family of a German baron, consisting of eight children. The practice, however, made little progress until 1768, when, after the inoculation of some members of the Imperial family, it became more general. In Berlin it fell into disfavour owing to several deaths from smallpox being attributed to it, and it was not until the end of the eighteenth century that attention was again called to the matter.

In Germany

In Italy, according to De La Condamine, inoculation was known and secretly practised by the Neapolitans, from an early period. He states that it was frequently performed by nurses, who were in the habit of inoculating the infants entrusted to their care, without even the knowledge of their parents, by rubbing the palm of the hand with variolous matter recently taken from a smallpox pustule.

In Italy

During the great epidemic of smallpox in 1754 the practice was introduced into Rome by Peverini, but he encountered considerable opposition, and it was not until some years afterwards that it became common in Italy.

Tronchin is said to have been the first to introduce the practice of inoculation into Holland in 1758, when he performed it on one of his sons; while in Switzerland a lady living in Lausanne inoculated her own child in 1751, and her example was speedily followed by others.

In Holland

Mead, writing in 1765, with reference to inoculation, states: "It was the invention of the Circassians, the women of which country are said to excel in beauty, upon which account it is very common, especially among the poorer sorts, to sell young girls for slaves to be carried away into

In Circassia

the neighbouring parts. When, therefore, it was observed that they who were seized with this distemper (smallpox) were in less danger, both of their beauty and their life, the younger they were, they contrived this way of infecting the body so that the merchandise might bring the greater profit."

In Russia, owing to the enthusiasm and interest taken in the subject by the Empress Catherine II, Dr. Dimsdale, a London practitioner, who had become recognised as a specialist in inoculation, was sent for to introduce the practice into that country. He was summoned to St. Petersburg in 1768, and first performed the operation on two boys of about fourteen years of age. The matter for their inoculation had been taken from a child of the poorer classes in the suburbs of St. Petersburg, who was said to be "pretty full of a distinct kind of small-pox." These were followed by four more youths, and a young maidservant, for further trial, and a case of natural smallpox with the eruption in a suitable stage for the purpose was chosen.

In Russia

These cases proving satisfactory, the Empress herself determined to undergo inoculation, and a child, on whom smallpox had just begun to appear, was selected and taken to the Palace. The operation was performed secretly, and was apparently unattended by any untoward results, as the lady is said to have taken part in every amusement "with her usual affability, without showing the least token of uneasiness or concern, and constantly dined at the same table with the nobility."

Shortly afterwards Dimsdale inoculated the Grand Duke, and for these royal services he was made a Baron of the Russian Empire, appointed Councillor of State, and Physician to Her Imperial Majesty. He was also awarded the sum of one thousand pounds in addition to an annuity of five hundred pounds.

At the request of the Empress, Dr. Dimsdale proceeded to Moscow, where many were desirous of being inoculated.

Dimsdale's method

With respect to his method, he restricted himself to inoculating by means of a lancet, the point of which was slightly dipped in variolous matter taken during the eruptive fever. The lancet was introduced obliquely beneath the superficial skin, making a very tiny puncture. If there were no patients in a proper state to yield the variolous matter, dried lymph was employed. The lancet or a plate of glass or gold was charged with the matter in a fluid state, which was then allowed to dry. When required for use it was held over the steam of boiling water, or a small quantity of water, barely sufficient for dilution, was added to it, and the matter thus moistened was used for the purpose of inoculation.

Some idea of the terrible mortality from smallpox in Europe at the end of the eighteenth century may be gathered from the fact that the average annual death-rate throughout the Continent was two hundred and ten per thousand. During epidemics this was even higher, and in Russia in one year no less than two million persons perished from the disease.

In America

In America, the practice of inoculation appears to have been first suggested at the time of the great smallpox epidemic, in 1721, by Cotton Mather, a clergyman. He was bitterly attacked, however, for recommending such a treatment, insomuch that his life was at one time in danger. In spite of this, he inoculated his son with success, and about the same time Dr. Zabdiel Boylston inoculated one of his children and two of his negro servants.

During the following six months he inoculated two hundred and forty-four persons, with the result, it is stated, that in six there was no effect at all, while six are said to have died in consequence of the inoculation. Boylston describes his method as follows:—

"Take your Medicine or Pus from the ripe pustules of the smallpox of the distinct kind, either from those in the natural way or from the inoculated sort, provided that the persons be otherwise healthy and the matter good. Then take a fine cut sharp tooth pick (which will not put the person in any fear as a Lancet will do in many) and open the Pock on one side and press the boil and scoop the matter on your quill and so on."

Boylston's experiments excited a great deal of opposition in America, and the practice fell into disrepute after a public meeting of medical practitioners had been called in Boston, where the practice was deprecated as causing the death of many persons, and it was contended that the operation was likely to prove of most dangerous consequences to those who submitted to it. Inoculation therefore made but little progress in America until 1764, when an epidemic of smallpox broke out in Boston, with the result that three thousand persons were successfully operated on.

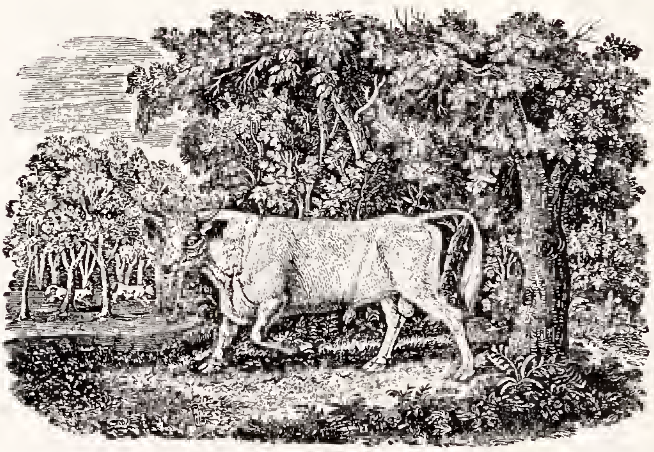
In South America, the practice of inoculation was introduced by a Portuguese Carmelite missionary. He appeared to have had no practical experience of it, but was a firm believer in its efficacy, and in 1728, when smallpox was ravaging the neighbourhood of Para, he performed the operation on a number of people with most satisfactory results. His example was successfully followed by another missionary at Rio Negro.

In Mexico

In Mexico, which was ravaged by epidemics of smallpox during the sixteenth century, inoculation was introduced in 1797, at the time of an epidemic in the environs of Mexico City. According to Humboldt, in his "Political Essay on the Kingdom of New Spain," 1808, in the capital of the bishopric of Michoachan, "out of 6,800 people inoculated only 170 died. Several individuals, especially among the clergy, displayed very praiseworthy patriotism in arresting the progress of the

disease by inoculation. There were then inoculated in the kingdom between fifty and sixty thousand individuals."

In January, 1804, vaccination was introduced into Mexico from North America, and made rapid progress. "If the vaccine inoculation," says Humboldt, "or even the ordinary inoculation, had been known in the New World in the sixteenth century several millions of Indians would not have perished victims to smallpox." For to this disease the great diminution in the number of Indians in California is to be ascribed.



CHAPTER III

Inoculation in the British Isles

"Buying the smallpox"

From well-authenticated statements it would appear that a method of inoculation for smallpox, similar to that employed in the East, was known and practised in the British Isles for a considerable period. How, and by whom, it was introduced into Britain we have not been able to trace, but apparently as early as the seventeenth century it was practised in Wales, and was called "buying the smallpox."

According to Williams, writing in 1722, the peasantry in Pembrokeshire had carried on the custom from time immemorial, by rubbing the matter taken from pustules that were ripe on several parts of the skin of the arm, or pricking the parts with pins that had been first infected with the matter. The writer declares, "I cannot hear of one instance of their having the smallpox a second time." He further states, "There is a married woman in the neighbourhood of this place who practised it on her daughter about a year and a half ago, by which means she had the smallpox favourably, and is now in perfect health, notwithstanding she has, ever since, without reserve, conversed with such as have had that distemper this last summer."

School-boys in the district are said to have even inoculated themselves in this way.

An old Welsh custom

Further evidence of the practice in Wales is recorded by a surgeon named Wright, of Haverfordwest. Writing in 1722, he refers to it as "a very antient custom, commonly called 'buying the smallpox,' which I find to be a common practice, and of very long standing. In two large villages near Milford Haven, named St. Ishmaels and Marloes, the oldest inhabitants declared it had been a common practice with them time out of mind, and one, William Allen, who was at that

LADY MARY WORTLEY MONTAGU
Daughter of Evelyn, Earl of Kingston

Born 1689 Died 1762

time ninety years of age, stated that it had been known and used throughout his life, and that he very well remembered his mother telling him it had been commonly done all her time, and that she got the smallpox that way."

There is evidence that in the Highlands of Scotland a method of smallpox inoculation was known about the same period. It was performed by charging worsted threads with the variolous matter, and tying them round the wrists. In the Island of St. Kilda it was customary to rub the matter on the skin of the elbow joint until it was absorbed.

In Scotland

In Ireland, the first record of the practice appears to be in 1723, when a medical practitioner in Dublin introduced it. During that year and the three following, twenty-five persons in all were inoculated, three of whom are said to have succumbed to the disease, and consequently the practice fell into disuse.

In Ireland

In England, there is no credible record of the practice before its introduction by Lady Mary Wortley Montagu, the wife of the British Ambassador to the Ottoman Court in 1717. The accounts of the practice in Turkey, which had been published in the *Transactions of the Royal Society*, by Timoni and Pylarini, in 1713, had caused but little interest, and it was only through the persistent efforts and enthusiasm of Lady Mary, who, to prove its efficacy, had her son inoculated, that serious attention was again directed to the matter in England.

In England

The famous letter which she wrote to her friend, Miss Sarah Chiswell, in 1717, in which she expressed her determination to persuade the physicians of London to practise inoculation, is worthy of quotation in full:—

"Apropos of distempers," she wrote, "I am going to tell you a thing that I am sure will make you wish yourself here. The smallpox, so fatal and so general amongst us, is here entirely harmless by the invention of *ingrafting*, which is the term they give it. There

is a set of old women who make it their business to perform the operation every autumn in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the smallpox. They make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nutshell full of the matter of the best sort of smallpox, and asks what veins you please to have opened. She immediately rips open that you offer to her with a large needle (which gives you no more pain than a common scratch), and puts into the vein as much venom as can lie upon the head of her needle, and after binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. The Grecians have commonly the superstition of opening one in the middle of the forehead, in each arm, and on the breast, to mark the sign of the cross; but this has a very ill effect, all these wounds leaving little scars, and is not done by those that are not superstitious, who choose to have them in the legs, or that part of the arm that is concealed. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have very rarely above twenty or thirty in their faces, which never mark; and in eight days' time they are as well as before their illness. Where they are wounded, there remain running sores during the distemper, which I don't doubt is a great relief to it. Every year thousands undergo this operation; and the French Ambassador says pleasantly that they take the smallpox here by way of diversion, as they take the waters in other countries. There is no example of any one that has died in it, and you may believe I am very well satisfied of the safety of the experiment, since I intend to try it on my dear little son. I am patriot enough to take pains to bring this useful invention into fashion in England; and I should not fail to write to some of

our doctors very particularly about it, if I knew any one of them that I thought had virtue enough to destroy such a considerable branch of their revenue for the good of mankind. But that distemper is too beneficial to them not to expose to all their resentment the hardy wight that should undertake to put an end to it. Perhaps if I live to return, I may, however, have courage to war with them. Upon this occasion admire the heroism in the heart of your friend."

Lady Mary was not long before she carried her decision into practice, and persuaded Dr. Maitland, who was surgeon to the Embassy in Constantinople, to procure some variolous matter from a suitable subject and to obtain the services of a woman, who was experienced in the practice of inoculation, to use it. In March, 1717, the inoculator, who was an aged Greek woman of Pera, came to the Embassy to meet Maitland, who had the matter ready. In his account of the operation he says: "The good woman went to work so awkwardly and by the shaking of her hand put the child to so much torture with her blunt and rusty needle that I pitied his cries, and therefore inoculated the other arm with my own instrument with so little pain that he did not even complain of it." The disease followed in due course, with the result of over a hundred pustules.

The Eastern method introduced

Thus, for the first time, the Eastern method of inoculation was performed on a British subject, an innovation due to the courage of Lady Mary Wortley Montagu, who practically risked her son's life for the purpose.

Four years later, an essay, entitled "A Dissertation on the Method of Inoculating the Smallpox," was published by Dr. De Castro, who advocated arm-to-arm variolation. He recommended physicians to introduce the practice into England, as he found it had always been attended by success.

Shortly after this Dr. Harris delivered a lecture before the Royal College of Physicians in London, in which he described the Byzantine and Chinese methods of inoculation. He also called attention to the method then used at Aleppo of inoculating by means of a thread which had been dipped in the variolous matter, which had been used with success upon four children of the French Consul in that city.

Lecture on Byzantine and Chinese methods

Meanwhile, Lady Mary Wortley Montagu had not been idle, and still enthusiastically carried on her crusade. The inoculation of her son in Constantinople having been successful and attended by no ill effects, in April, 1721, she decided to have her baby girl, a child three months old, inoculated in the same way. She was staying in England at the time, and Dr. Maitland, who had been present at the inoculation of her son, being also in this country, consented to carry it out, and the operation was done in the presence of several of the Court physicians.

In the following year Maitland inoculated the son of Dr. Keith, with favourable results.

The subject excited considerable interest at the time throughout the country and was much commented upon, but the British public, ever conservative in adopting new customs, still regarded the practice with suspicion, and a certain amount of dread, and so for a time it made little progress.

In August, 1722, a suggestion was made to inoculate some criminals, then undergoing imprisonment in Newgate, with variolous matter, and those who submitted were promised a full pardon. Several accepted the offer, and six men were accordingly inoculated by Maitland under the direction of Sir Hans Sloane, on August 9, 1722. Maitland's method of inoculation was to make an incision through the cutis, and apply pledgets

Experiments on criminals

which had been steeped in the variolous matter from ripe pustules. None of the men suffered severely, and only sixty pustules appeared on the one on whom the inoculation produced the most effect. A seventh criminal, named Elizabeth Harrison, a girl of about eighteen years of age, was next experimented on by Dr. Mead, who used the Chinese method of inoculation. It was followed by a mild type of the disease, accompanied by severe pains in the head from the commencement of the eruption, but the girl made a good recovery.

Inoculation of forty individuals in Yorkshire

During the next six months Maitland inoculated only eight persons, but Nettleton, a medical practitioner of Halifax, Yorkshire, who became an enthusiastic believer in the practice, inoculated forty individuals in three months. His method was to first prepare the patient by the administration of a course of aperients, emetics and occasional bleeding. When inoculating, he made two incisions, one in the arm, and one in the leg on the opposite side of the body, and dropped the variolous matter into them. With his later patients he employed another method, which consisted in impregnating cotton wool with the variolous pus, and applying it to the incision for twenty-four hours.

Royal children inoculated

Towards the close of the year 1722, public attention was again drawn to the subject by the announcement that the Princess of Wales had ordered five charity children of the parish of St. James's to be inoculated. The results were successful, and this decided the Princess to have her two young children operated upon in the same way. Although a mild attack of the disease followed, no serious results of the operation occurred, and the practice, thus encouraged by royal favour, received a fresh impetus.

This, however, was soon checked by the announcement of the death of the Hon. William Spencer, and

several other cases which terminated fatally from smallpox after inoculation.

Opposition to the practice now sprang up both from physicians and clergymen, who spoke and wrote against it, and a heated controversy speedily developed. The clergy declared the custom to be the outcome of quackery, atheism and avarice, and one divine who preached against it, stigmatised it as "a dangerous and sinfull practice." Maitland, especially, was taken to task in connection with the fatal results which had attended so many persons he had inoculated. To these criticisms the supporters of inoculation replied, and a vigorous discussion followed in the press and in the form of pamphlets published by exponents on both sides.

Opposition to the practice

Notwithstanding this, however, the practice continued to make steady progress in England. Jurin, who published some letters on the subject at this time, stated that, in accordance with statistics, among children born, one in fourteen died in after life from smallpox if uninoculated, while of the inoculated persons only one out of ninety-nine succumbed to the disease. He qualified his recommendation by stating that care should be taken only to inoculate those "who were of good habit of body," and apparently free from any disease.

In 1746, an Inoculation Hospital was established in London, although prejudice still ran high against the practice. Patients, on leaving the hospital, it was said, were often abused and followed in the street by the anti-inoculators, and many had even to remain in the building until night, unable to leave on account of the danger of insult and assault in the streets.

Inoculation Hospital established

In 1747, Dr. Mead, who was at that time at the zenith of his fame as a fashionable and popular physician, published an article in favour of the practice,

and, on behalf of the church, Dr. Maddox, then Bishop of Worcester, also become a powerful supporter of inoculation, and preached a sermon on the subject, which was published and attained considerable popularity.

At the beginning of the year 1754 public attention was aroused by the announcement that the Prince of Wales had been stricken down by smallpox, and, on the advice of the Court physicians, it had been decided to inoculate Prince Edward and Princess Augusta with variolous matter taken from the royal patient.

Inoculation of Prince Edward

This aroused a fresh controversy on the vexed question, and, after some consideration, the following manifesto was published by the Royal College of Physicians in 1754:—

"The College, having been informed that false reports concerning the success of inoculation in England have been published in foreign countries, think proper to declare their sentiments in the following manner, viz.: That the arguments which at the commencement of this practice were urged against it have been refuted by experience; that it is now held by the English in greater esteem, and practised among them more extensively than ever it was before, and that the College thinks it to be highly salutary to the human race."

Manifesto by Royal College of Physicians

In 1757, interest was again revived in the subject by the announcement of a new method of operation, discovered by Robert Sutton, an unqualified practitioner, who soon achieved considerable fame as a successful inoculator. Sutton lived at Debenham, Suffolk, and the success attending his inoculations soon spread throughout the country, insomuch that in the course of eleven years it is stated that he inoculated 2,514 individuals. His practice so increased that he trained his two sons, Robert and Daniel, to assist him,

and they eventually opened an Inoculation House near Ingatestone, in Essex, where patients became so numerous that it was difficult to accommodate them in the village.

Sutton claimed that by the use of certain medicines and treatment, he was enabled to keep the disease contracted after inoculation entirely under his control, and maintained that no fatal results had ever ensued from his method. The details of this he kept a profound secret, and, as his fame increased, so the envy of the physicians of the period was aroused, and every effort was made to try and find out the secret of his success. Samples of the medicines he prescribed were with difficulty obtained, and subjected to analysis both by physicians and chemists, and his patients were plied with all kinds of interrogations after they had passed from under his care, but all without avail. In the end he agreed to communicate his method to any practitioner at a distance away from where he lived, on condition that he received half the profits that accrued, and thus eventually his method became known.

Sutton's method

Patients who desired to be inoculated by him were first kept on a strict dietary for a fortnight, and a certain powder together with a dose of purging salts, was administered during this time. His method of inoculation, as given by himself, was to take a lancet charged with the smallest possible quantity of the unripe, crude or watery matter from the pustules, and then insert it under the cuticle obliquely in the outer part of the arm, between the scarf and the true skin, barely sufficient to draw blood and not deeper than the sixteenth part of an inch. The raised skin was then pressed down by the finger without further application of plaster or bandages. He considered patting or daubing of the matter over the punctured place as unnecessary.

Dietetic and medicinal preparation for inoculation

Dr. Dimsdale, who afterwards achieved fame as an inoculator in Russia, as already related, was one of the first to turn Sutton's method to account, and, with some slight alteration, he practised it with great success. Previously, he had applied a piece of thread which had been drawn through a ripe pustule, and well moistened with the matter, to an incision made in one or both arms, but this method he abandoned for one adapted from Sutton's. For nine or ten days before the operation his patients were enjoined to abstain from all animal food and fermented liquor, and to live on a low diet. During this time they were dosed with a powder composed of eight grains of calomel, eight grains of compound powder of crab's claws, and one-eighth part of a grain of tartar emetic. Three doses of this powder were given, one at the commencement of the treatment, the second in three or four days, and the third about the eighth or ninth day.

Adopted by Dr. Dimsdale

In 1766, Burgess called attention to the necessity of preparing the patient, before inoculation, by means of purgatives.

The practice of direct inoculation, however, was still regarded with suspicion by the majority of people, owing to its uncertainty, and it gradually became evident that not only did it fail to exterminate the disease, but actually spread it, and in many cases smallpox was introduced by inoculation into towns which had been free from the natural disease.

There can be no doubt that inoculation lessened the virulence, and, to some extent, diminished the dangers of an attack of smallpox, but smallpox still continued, and, as no precautions against infection were taken, each case only served to spread the disease. One of Maitland's earliest cases, a child of the name of Mary Butt, is said to have infected six servants who had attended her; and in the report of a case recorded by Willan,

Effects of inoculation

of a child whose parents kept a shop in a court consisting of about twenty houses, it is stated that the disease was contracted by seventeen persons who had frequented the shop within a fortnight of the child's recovery, and eight of them died from the disease.

Gradually the practice fell into disuse, and disappeared on the advent of vaccination, direct inoculation by smallpox matter being finally forbidden by Act of Parliament in 1840.

CHAPTER IV

The Genesis of Vaccination

In studying the history of medicine one cannot fail to notice how much we owe to antient customs which have come down to us from traditions of the past, and how many so-called modern discoveries are but re-introductions of practices of remote antiquity.

Thus it was from the old traditions of ignorant cow-herds and dairy-maids that the theory of vaccination of the human being with cowpox as a preventive of smallpox was evolved. From an unknown period farm hands, who had had the care of cattle, had known of a disease among cows which was called "cowpox," and were aware that they were liable to contract the complaint from the animal, especially when milking. It had further been noticed that those who had had the cowpox were not susceptible to the dreaded smallpox, which was so prevalent in England a century or more ago.

Cowherd tradition

Dr. Corlett states that in the time of Charles II, the court ladies and other devotees of fashion looked with envy upon the immunity enjoyed by some of the dairy-maids in Gloucestershire to the pitting of smallpox.

He relates the following curious story of the Duchess of Cleveland (1670), who, it is well known, was a favourite with the king, and celebrated for her great beauty. When joked by the courtiers on the possible loss of her position at court through the disfigurement of smallpox, she is said to have replied that she had nothing to fear, for she had had cowpox.

In Ireland, according to Barry, cowpox had been known as long as smallpox, and about 1750, an aged woman, eighty years of age, stated that she was certain that as long as she could remember the opinion had prevailed that people who had had the cowpox could

BENJAMIN JESTY
From the original oil painting

not take the smallpox, and that many purposely exposed themselves to the former, to protect themselves from smallpox.

This tradition, however, does not appear to have been universal, and in some parts of the country it appears to have been unknown. Jenner believed that it arose as the result of smallpox inoculation, and that the failure in attempting to inoculate smallpox on those who had recently contracted cowpox gave rise to gossip among those who were employed in dairies, and laid the foundation of the popular tradition.

In 1769, Jobst Böse, a Government official in Germany, called attention to the fact that those who had suffered from cowpox, were believed to be protected from smallpox. He states: "I am reminded of the not unknown attacks of cowpox which were prevalent in this country, and to which to this day milkmaids are subject. In passing, I wish to remark that in this country those who have had the cowpox flatter themselves to be entirely free from all danger of getting smallpox, and assert, as I myself, to have heard this same statement made by entirely reliable persons."*

The first record of the tradition being put into practical use is recorded in the papers of Mr. Nash, a medical practitioner who died in 1785, among which were found the following observations:—

First practical use of the tradition

"I never heard of one having the smallpox who ever had the cowpox. The cowpox certainly prevents a person from having the smallpox. I have now inoculated about sixty persons, who have been reported to have had the cowpox, and I believe at least forty of them I could not infect with the variolous virus. The other twenty, or nearly that number, I think it is very reasonable to presume (as they were no judges), had not the real cowpox. It is not my own opinion only, but that of several other

* "General Conversations of Göttingen," Part 39, May 24, 1769

The Cow Pock ... or ... *the Wonderful Effects of the New Inoculation!* ...

medical gentlemen, that convinces me the cowpox is a prophylactick for the smallpox. My principal intention in publishing being to recommend to the world a method of inoculation that is far superior in my opinion (and I judge it from experience) to any yet made known; therefore I hope and trust, although I have no medical friend to enforce it upon the world, that they will give me so far credit for my assertions as to make the experiment, and then it will sufficiently introduce itself."

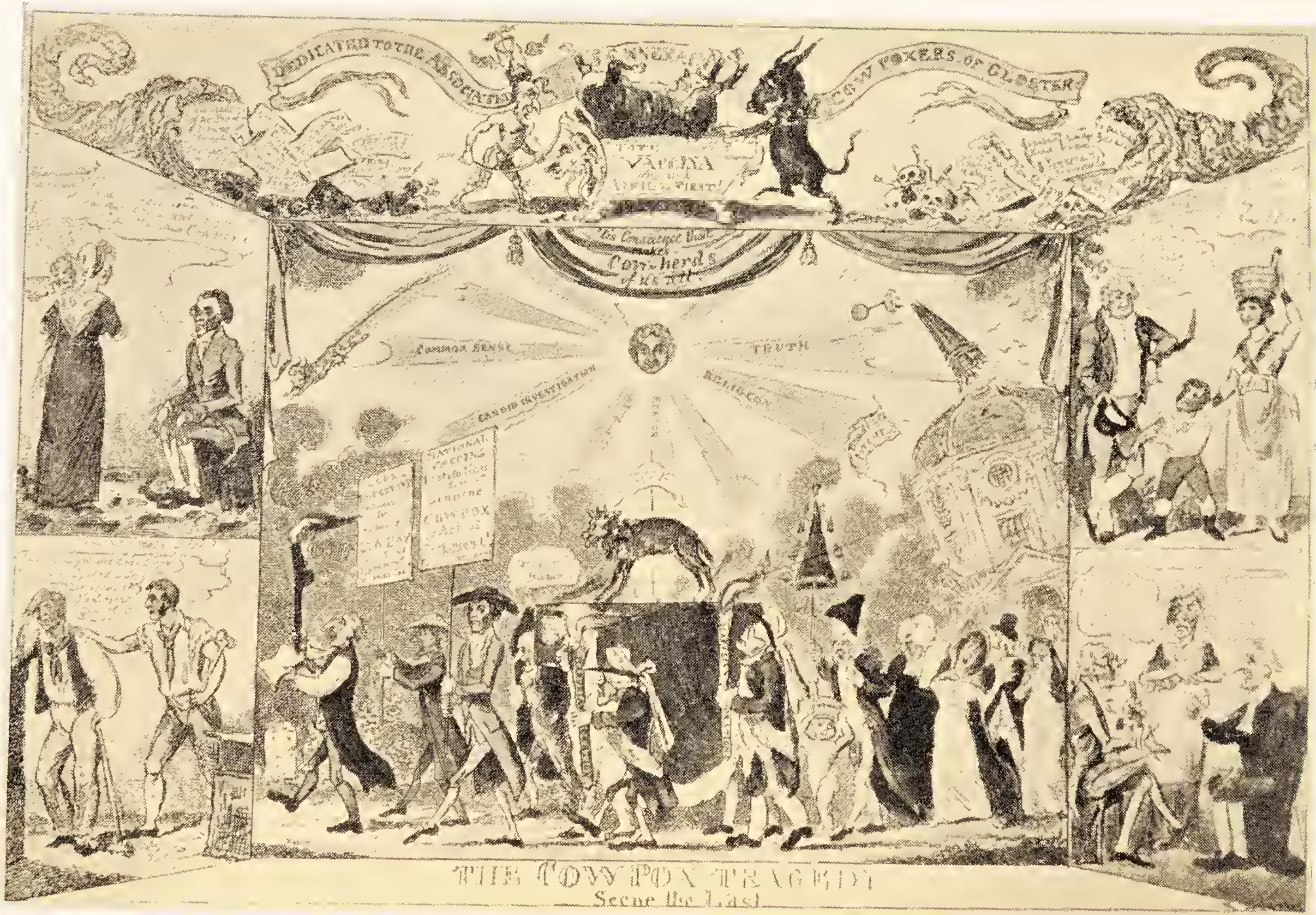
These notes of Nash's were written about the year 1781, and after his death were passed to a Mr. Thomas Nash, and from him to Mr. Robert Keate. According to Crookshank, Jenner was acquainted with Nash.

Rolph's experiences

Another observer who was well acquainted with cowpox was Rolph, who practised for nine years in Gloucestershire about this period. He had noted that out of hundreds of cases that had come under his observation, not a single one had proved either dangerous or fatal. He also states: "There is not a medical practitioner of even little experience in Gloucestershire, or scarce a dairy farmer, who does not know from his own experience, or that of others, that persons who had suffered from cowpox are exempted from the agency of the variolous poison."

Downe records that cowpox inoculation was practised in several cases with success as early as 1771, and he relates the case of a butcher near Bridport, who was inoculated with cowpox matter, by means of a needle, in two or three places on his hand. He afterwards came repeatedly into contact with persons suffering from smallpox, but never contracted the disease.

One of the most interesting incidents, however, in the history of cowpox inoculation is that of Benjamin Jesty, a farmer living at Yetminster in Dorset, who carried on a large business as a cattle dealer. In


COW POXERS OF GLOSTER
COMMON SENSE
TRUTH
CANDID INVESTIGATION
RELIGION
THE COW POX TRAGEDY
Scene the Last

the year 1774 he inoculated his wife and three of his children with cowpox matter. Mrs. Jesty was inoculated in the arm under the elbow, and her sons above the elbow, the incision being made with a darning needle, and the virus taken on the spot from the cows of a farmer at Chittenhall, whither Jesty had taken his family. The sons developed the disorder in a favourable way, but Mrs. Jesty's arm became much inflamed.

A farmer inoculates his family with cowpox

As Jesty's experiment became known, the boldness and novelty of it created great interest and caused quite a sensation in the neighbourhood.

The causes that led the country farmer to the idea of inoculation with cowpox matter may best be gathered from his own story, which he communicated to the Rev. Dr. Bell, of Swanage:—

"When the smallpox raged in the vicinity and inoculation was introduced into the village (Yetminster), alarmed for the safety of his family, he bethought himself of this expedient. There had been in his family two maidservants, who, after having the disorder from the cows, and knowing this to be a preventive of the smallpox, had attended, the one her brother, the other her nephew, in the natural smallpox, without taking the infection. This circumstance led Mr. Jesty to communicate by inoculation the disorder of the cows to his family. For this purpose he carried them to the field of a neighbouring farm, and, as has been related, performed the operation on the spot.

"To the other question, how did it happen that this discovery expired at its birth, a ready solution will be found in the character of the ingenious farmer whose pursuits were widely different from those of medicine, literature or science, and in the natural prejudice of mankind strengthened by the alarm which the inflammation of Mrs. Jesty's arm had excited. To such a height was this prejudice carried that a

neighbouring surgeon, whose name I have not been able to learn, had almost lost his practice from the bare proposal of following up Mr. Jesty's bold and successful experiment."

Over thirty years afterwards this statement, duly attested, was forwarded to the Jennerian Society in London by Dr. Bell, and it was accepted as satisfactory evidence of Jesty's discovery. The Society invited him to pay a visit to the metropolis for the purpose of having his portrait painted, as the earliest inoculator of cowpox. The worthy farmer accepted the invitation, and, accompanied by his son Robert, whom he had inoculated in 1774, he journeyed to London. According to an account of the visit, written at the time, the pair "met with great attention from the members of the Society, who were much amused with Jesty's appearance and manners. Before he left his country home his family had tried to induce him to attire himself more fashionably for his visit to the metropolis, but without effect. 'I do not see,' said the bluff old farmer, 'why I should dress better in London than in the country,' and so he appeared before the Jennerian Society in his country farmer's clothes, which are described as being peculiarly old-fashioned. In order to prove their statement, Robert Jesty willingly consented to be inoculated for the smallpox, and his father for the cowpox, but neither took effect."

The earliest inoculator of cowpox

Jesty was then invited to sit for his portrait to Mr. Sharpe, an artist, and the picture, when finished, was to be presented to him. But the old farmer proved an impatient sitter, and could only be kept quiet by the artist's wife playing to him on the piano. The portrait when completed was presented, together with a pair of very handsome gold-mounted lancets, to Jesty, and the members of the Jennerian Society signed the following statement, which accompanied the presentation:—

"Mr. Benjamin Jesty, farmer, of Downshay, in the Isle of Purbeck, having visited the original Vaccine Pock Institute, Broad Street, Golden Square, London, in August, 1805, we think it a matter of justice to himself, and beneficial to the public, to attest that among other facts he has afforded decisive evidence of his having vaccinated his wife and two sons, Robert and Benjamin, in the year 1774, who were thereby rendered unsusceptible of the smallpox, as appears from the exposure of all the parties to that disease frequently the whole course of thirty-one years."

Thus, through Jesty's visit to London, he satisfactorily established his claim as the first inoculator for cowpox. He died in 1816, and was buried in the churchyard of Worth Matravers, near Swanage, and his tombstone bears the following inscription:—

Sacred
To the Memory
of
BENJ^N. JESTY (of DOWNSHAY)
Who departed this life
April 16th, 1816
Aged 79 years

He was born at Yetminster in this County, and was an upright Honest man; particularly noted for having been the first Person (known) that introduced the Cow Pox by inoculation, and who, from his great strength of mind, made the experiment from the Cow on his wife and two sons in the year 1774.

His wife, who was thus the first person known to have been intentionally inoculated with cowpox, lived to the age of eighty-four, died in the year 1824, and was buried by the side of her husband.

THE OLD VICARAGE, BERKELEY, WHERE DR. EDWARD JENNER

CHAPTER V

The Discoverer of Vaccination

The close of the eighteenth century saw the dawn of a new era in preventive medicine, by the discovery and establishment of the value of vaccination by Edward Jenner, whose name will ever be remembered as the vanquisher of smallpox, which for centuries before his time had ravaged the world.

Edward Jenner

He was born in the year 1749, at Berkeley, in Gloucestershire, and was the third son of the Rev. Stephen Jenner, the vicar of that place. At the period of Jenner's birth, inoculation was being vigorously advocated as a preventive of smallpox, and when he was but eight years of age, his parents having decided that he should be inoculated, he was promptly put under a preparatory regimen. "For six weeks," he tells us later, "he was bled and purged, and kept on a low diet, and dosed with medicine, and was then removed to one of the so-called inoculation stables, and haltered up with others in a terrible state of disease." Jenner was fortunate to escape with a mild attack, but it affected his health for many years afterwards, and it is probable that the experience he then went through made such an impression upon his mind that he eventually began his investigations on the prevention of the disease.

At the age of thirteen he decided to follow the profession of medicine, and was apprenticed by his father to Messrs. Ludlow, a firm of surgeons in Sodbury, near Bristol, with whom he remained for six years. It was during this period of his apprenticeship that one day a young country woman came to seek medical advice. and, the subject of smallpox having been mentioned, she exclaimed, "I cannot take it, for I have had cowpox." Her reply seemed to have made a deep impression on Jenner, and doubtless set him thinking as to why this should be.

DR. EDWARD JENNER

From an engraving by W. Read

Apparently he never forgot it, but marked it out for a new line of research.

On attaining his majority, he came to London and entered as a house pupil with the famous John Hunter, and assisted him in forming his museum. It is said that he often discussed the subject of smallpox with the great anatomist, and on one occasion when relating his hopes and fears of the possibility of substituting vaccination for inoculation, the characteristic reply of the great surgeon was: "Don't *think*, Jenner, but *try*."

Pupil of John Hunter

Tiring of town life, he resolved, after a time, to return to his native village, and there he settled down as a country practitioner, occasionally visiting Cheltenham, where, on account of his London experience, he was sometimes called in consultation by local practitioners.

During his early days in Berkeley, about 1778, he wrote to John Hunter, telling him that he had unfortunately fallen in love, and he regretted to inform him that his suit did not prosper. Hunter's amusing reply, in which he recommends his old pupil to study hedgehogs as a cure for love-sickness, is characteristic of the man. It was as follows:—

Hunter's letter to Jenner

"Dear Jenner,—I own I was at a loss to account for your silence, and I was sorry for the cause. I can easily conceive how you feel, for you have two passions to contend with, viz., that of being disappointed in love, and that of being defeated; but both will wear out, perhaps the first soonest. I own I was glad when I heard you were to be married to a woman of fortune; but let her go, *never mind her*. I shall employ you with hedgehogs, for I do not know how far I may trust mine. I want you to get a hedgehog in the beginning of winter, and weigh him, put him in your garden, and let him have some leaves, hay, or straw, to cover himself, which he will do, then weigh him in spring, and see what he has lost. Secondly, I want you to kill one at the beginning of winter, to see how fat he is;

and another in spring, to see what he has lost of his fat. Thirdly, when the weather is very cold, and about the month of January, I could wish you would make a hole in one of their bellies, and put the thermometer down into the pelvis, and see the height of the mercury; then turn it upwards towards the diaphragm, and observe the heat there. So much at present for hedgehogs. London, 1778."

Some years later, Jenner married a Miss Kingscote, and his married life was a long and happy one.

In the year 1780, he determined to take up the study of cowpox, and in the month of May in that year he first disclosed to his friend Edward Gardner his future hopes respecting the great object of his pursuit.

Jenner described

Describing his personal appearance about this time, Gardner says: "He was rather under middle size, but robust, active and well formed. He was particular in his dress, and when I first met him at Frampton Green, he was clad in a blue coat with yellow buttons, buckskins, well-polished jockey boots with handsome silver spurs, and carried a smart whip with a silver handle. His hair, after the fashion of the time, was done up in a club, and he wore a broad-brimmed hat."

Jenner confides in Gardner

One can readily picture Jenner and his friend as they rode together on the road between Gloucester and Bristol, when the following conversation took place. After relating the natural history of cowpox, Jenner gave his opinion as to its origin from the heel of the horse, specifying the different kinds of disease which attacked milkmen when they handled infected cows. He dwelt upon that variety which afforded protection against smallpox, and with deep and anxious emotion mentioned his hope of being able to propagate that variety from one human being to another, until he had disseminated the practice all over the globe to the total extinction of the dread disease. "Gardner," he concluded, addressing his

DR. EDWARD JENNER INOCULATING HIS SON, EDWARD, A
THE AGE OF EIGHTEEN MONTHS, WITH SWINEPOX MATTER
NOVEMBER, 1789

friend, "I have entrusted a most important matter to you, which I firmly believe will prove of essential benefit to the human race. I know you, and should not wish what I have stated to be brought into conversation, for should anything untoward turn up in my experiments I should be made, particularly by my medical brethren, the subject of ridicule, for I am the mark they all shoot at."

It was about this period Jenner came to the conclusion that the grease of horses, a disease well known to farriers, was the same as cowpox and smallpox. One day, accompanied by his nephew, George Jenner, when looking at a horse with diseased heels, he exclaimed, pointing to the infected part, "There is the source of smallpox. I have much to say on that subject, which I hope in due time to give to the world."

"Grease" and smallpox

He satisfied himself that two forms of disease had been hitherto confounded under the name of cowpox, only one of which protected against smallpox. Many cases of failure, he judged, were thus to be accounted for. His next step was to ascertain that the true cowpox itself only protects when communicated at a particular stage of the disease.

Just at this time, however, there was little opportunity of studying cowpox in that part of Gloucestershire. Few cases had been seen, and he had no opportunity of inoculating the disease, and so putting his theories to the test. But he steadily pursued his investigations, and in 1788 he had a drawing made of the hand of a milkmaid with cowpox, which he took with him to London to show Sir Everard Home, who agreed that it was interesting and curious, and the subject began to be talked about in medical circles in London.

While deliberating on the subject of vaccine inoculation, he made some experiments on swinepox, which he believed to be of similar origin to common variolæ. In November, 1789, he inoculated his son

Edward, who was then about eighteen months old, with some swinepox matter which he had collected. He watched the result with the greatest anxiety and interest, and noted that the progress of the disease seemed similar to that arising from the insertion of true smallpox when the attack was slight. No harm apparently resulting to the boy, on April 7, 1791, he inoculated him again, and although a vesicle appeared and there was some erysipelas, it quickly died away, and the child showed no sign of indisposition the whole time.

In 1796, an excellent opportunity occurred for an important experiment. Cowpox broke out in a farm near Berkeley, and a dairymaid named Sarah Neames contracted the disease. Jenner seized the opportunity and resolved to put his theories to a practical test, and on May 14 he took some matter from a sore on the maid's hand, and inserted it by means of superficial incisions into the arm of James Phipps, a healthy boy about eight years of age. The inoculation succeeded, the result being described as similar to that produced by inoculation with variolous matter. The whole died away, leaving scabs, and subsequent eschars. After a period of six weeks had elapsed, Jenner determined to try the effect of variolous inoculation, and on July 1 he inoculated the boy with variolous lymph by means of punctures and slight incisions, and was delighted to see that no smallpox followed.

Jenner's theories tested

These results he communicated in the following letter to Gardner:—

"Dear Gardner,—As I promised to let you know how I proceeded in my inquiry into the nature of that singular disease, the cowpox, and, being fully satisfied how much you feel interested in its success, you will be gratified in hearing that I have at length accomplished what I have been so long waiting for, the passing of the Vaccine Virus from one human being to another by the ordinary mode of inoculation.

"A boy of the name of Phipps was inoculated in the arm from a pustule on the hand of a young woman who was infected by her master's cows. Having never seen the disease but in its casual way before, that is, when communicated from the cow to the hand of the milker, I was astonished at the close resemblance of the pustules, in some of their stages, to the variolous pustules. But now listen to the most delightful part of my story. The boy has since been inoculated for the smallpox, which, as I ventured to predict, produced no effect. I shall now pursue my experiments with redoubled ardour.—Believe me, yours very sincerely, Edward Jenner, Berkeley, July 19, 1796."

To confirm his experiments, and make his discovery certain, he resolved to repeat it before publishing the facts to the world. But again, the disappearance of cowpox in the dairies delayed him, and in the meantime he resolved to prepare a paper on the subject to send to the Royal Society.

Early in the year 1797, owing to an outbreak of cowpox, an opportunity again occurred, and he inoculated three other persons with success. He then completed his paper, and revised it for publication.

Jenner publishes his paper

He first transmitted the manuscript to the Royal Society, and it was submitted to the Council, but after some time was returned to him, as they apparently thought the evidence was not strong enough to warrant publication in their *Transactions*. Jenner, undaunted, resolved to publish the paper himself, and about the end of June, 1798, it was printed, with additions, in the form of a pamphlet, entitled:

"Inquiry into the Causes and Effects of the Variolæ Vaccinæ, a Disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of the Cowpox."

In this historic pamphlet, which led to such important results, Jenner begins by describing the disease of the horse called by farriers, "the grease," which he

Two Ivory Scarifiers and Seven Lancets used by Dr. Jenner in his First Experiments

describes as "an inflammation and swelling in the heel, from which issues matter possessing properties of a very peculiar kind. It is capable of generating a disease in the Human Body (after it has undergone the modification which I shall presently speak of) which bears so strong a resemblance to the smallpox, that I think it highly probable it may be the source of that disease. . . . In this dairy country," he continues, "a great number of cows are kept. The office of milking is here performed indiscriminately by both Men and Maid-servants. One of the former having perhaps been appointed to apply dressings to the heels of a Horse affected with the Grease, and not paying due attention to cleanliness, incautiously bears his part in milking the cows, with some particles of the infectious matter adhering to his fingers. Should this be the case, it commonly happens that a disease is communicated to the Cows, and from the Cows to the Dairy-maids, which pretty rapidly spreads until most of the cattle and domestics of the farm feel its unpleasant consequences."

Its contents summarised

Jenner thus accounts for the origin of cowpox, the characters of which he then describes in detail. He assumed that virus from the horses' heels was intensified by being passed through the cow, on the ground that the horse so rarely affects his dresser with sores, while a milkman rarely escapes infection from the cow.

While in London concerning the publication of the pamphlet, Jenner called on Mr. Cline, and left with him some of the cowpox virus for trial. Having a young patient suffering from an affection of the hip joint, Cline thought that the counter irritation excited by the cowpox might prove beneficial, and in July, 1798, he inserted some of it into the patient's hip by means of two punctures. The result corroborated Jenner's experiments, the child sickened on the seventh day, and the fever subsided on the eleventh. The patient was

Independent confirmation

An Inquiry into the natural History of a Disease known in Glostershire ~~under~~ by the name of the Cow-pox

The deviations of Man from the state in which he was originally plac'd by Nature seem to have proved to him a prolific source of Diseases. From the love of Splendor, from the indulgences of Luxury, & from his fondness for amusement, he has familiariz'd himself with a great number of animals ~~that~~ which may not originally have been intended for his associates. The Wolf, disarm'd of ~~its~~ ferocity, is now pillow'd in the Lady's lap.* The Cat, the little Tyger of

* The late Mr John Hunter proved by experiments that the Dog is the Wolf in a degenerated state.

FIRST PAGE OF JENNER'S ORIGINAL MANUSCRIPT FOR HIS PAMPHLET:

"An inquiry into the natural history of a disease known in Glostershire by the name of the Cowpox"

afterwards inoculated with smallpox matter in three places without contracting the disease, and Cline, writing on August 2, 1789, states: "I think the substitution of cowpox poison for smallpox promises to be one of the greatest improvements that has ever been made in medicine. The more I think on the subject, the more I am impressed with its importance."

Jenner's critics

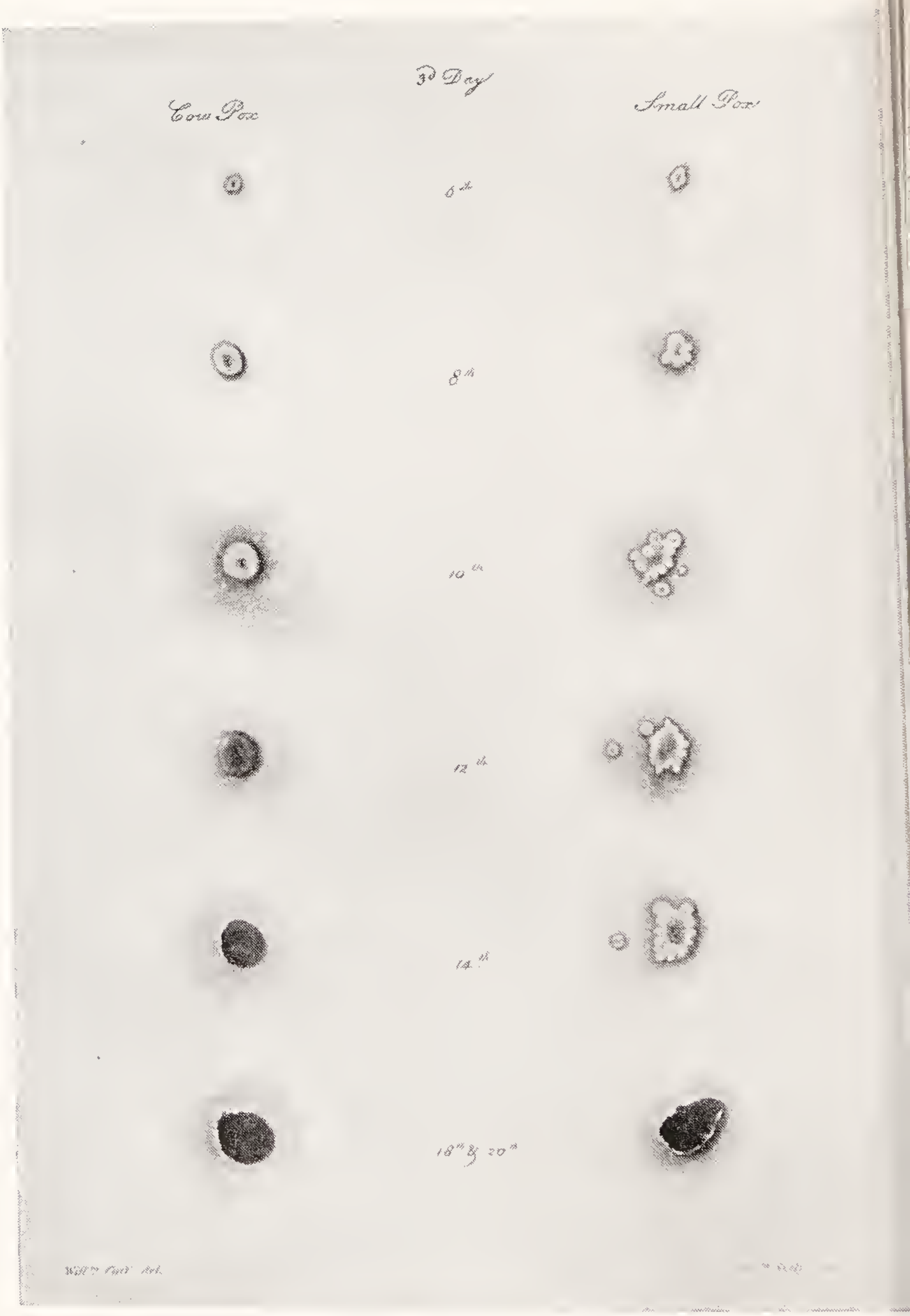
Ingenhousz, a well-known physician and scientist of the time, was the first critic of Jenner's discovery. In the autumn of the same year he opposed the cowpox theory, and cited certain cases where smallpox had been contracted after inoculation by cowpox. Jenner recognised a formidable antagonist in Ingenhousz, whose criticism did a great deal to weaken Jenner's position. The leading scientific and medical men in London next took up the subject, and several questioned the accuracy of Jenner's observations, and stigmatised his doctrines as conjectural and ridiculous.

Others, such as Pearson and Woodville, although adopting Jenner's ideas, endeavoured to exploit them on lines of their own, which proved a failure. Their experiments were attended with somewhat serious results, and for a time stopped the progress of Jenner's work.

Both held important positions, being physicians to the Smallpox Hospital in London, and it is stated that the experiments they commenced to carry out on vaccination were so carelessly performed that they were practically useless. It was further said that the vaccine they used was actually disseminating the disease they wished to prevent.

Jenner comes to London

Jenner, hearing of this, and fearing that their failures would seriously rebound on him, decided to come to London, and in the early part of the year 1799 he came up to the metropolis. He at once set to work to rescue his discovery from destruction, and to expose the errors which had been committed by his imitators. He



ORIGINAL ILLUSTRATION FOR JENNER'S "INQUIRY," REPRESENTING COWPOX AND SMALLPOX PUSTULES ON THE THIRD DAY OF ERUPTION

gathered around him a goodly band of enthusiastic supporters, and they set to work to counteract the evil done to their cause.

The word "vaccination" was the name first given in France to Jenner's method of cowpox inoculation. The method was based almost exactly on the earlier practice of inoculation, the cowpox matter being inserted under the skin of the arm by a lancet point. In 1799, Woodville started a succession of arm-to-arm vaccinations, so that the matter could be passed from one person to another with the same result. This method proving successful, it became commonly adopted in practice.

Meanwhile, Pearson, not to be outdone, decided to establish an institution of his own for the inoculation of cowpox, and appointed a Vaccine Board, of which he himself was the Principal, and the Duke of York consented to become a Patron. He wrote to Jenner offering to make him an "extra corresponding physician," but Jenner, thinking that sufficient consideration had not been shown to him in the matter, declined the offer.

Jenner now returned to Berkeley to complete a second paper on which he was engaged in reply to the criticism of his opponents, and shortly afterwards published it in the form of a pamphlet, entitled, "A Continuation of Facts and Observations relative to the Variolæ Vaccinæ."

Jenner introduced to Royalty

Soon after its publication he returned to London, and communicated with Lord Egmont, asking for an interview, so that "he might submit a plan by which the country might derive the advantages of his discovery, and profit by his advice." He also had audience with the Duke of Clarence, and eventually submitted a scheme for the establishment of a public institution for vaccine inoculation. He ultimately succeeded in inducing the Duke of Clarence and Lord Egmont to withdraw from

Pearson's projected institution, and was presented by Lord Berkeley to the King, the Queen, and the Prince of Wales, whose encouragement gave him fresh hope and materially aided the spread of the vaccination propaganda throughout the country.

Vaccination in America

The practice of vaccination was soon taken up in America, and was introduced and made known by Dr. Waterhouse, of Cambridge, Massachusetts, who published an article in the *Columbian Sentinel*, in March, 1797, entitled "Something Curious in the Medical Line." Thus, with characteristic enterprise, did the Americans grasp a discovery but just made in the land of its birth, and at a meeting of the American Academy of Arts and Sciences, presided over by John Adams, then President of the United States of America, the subject was attentively considered, and no time was lost in endeavouring to procure a supply of vaccine matter.

This was received in June, 1800, and, on July 8, Waterhouse vaccinated one of his sons, aged five years, this boy being the first person to be vaccinated in America. Finding the results successful as compared with Jenner's experience, he vaccinated several other members of his family, and also subjected them to smallpox inoculation afterwards. Finding the children resisted the disease even when subjected to the most crucial test, Waterhouse exclaimed, "One fact in such cases is worth a thousand arguments."

He was anxious that the benefits of vaccination should be diffused throughout the Continent, and his efforts attracted the attention of Thomas Jefferson, then President of the United States of America, who took a considerable interest in the subject. Jefferson had some of the members of his family vaccinated in August, 1801, and from his own family the President supplied Dr. Gantt with a small quantity of vaccine matter. Thus the seed of vaccination was planted at the capital of the United States.

VACCINATION

"Ah! doctor, I did well in not allowing myself to be vaccinated on the arm . . . it leaves a mark . . . and then my husband finds that I have a fine leg."

"He was not aware of it?"

"He!! Never!"

From a French caricature by Carlo Gripp

The propaganda next spread over the continent of Europe, and vaccination was demonstrated in Vienna by De Carro in 1799, and its importance once being realised, it was taken up with enthusiasm in Switzerland, France, Italy and Spain. In the latter country, the Government despatched an expedition in 1803 for the purpose of introducing vaccination throughout the Spanish possessions of the Old and New Worlds. The vessel in which the expedition sailed carried twenty-two unvaccinated children, who were to be vaccinated on the voyage in order to preserve the vaccine by passing it from arm to arm. In South America, in Sicily, and Naples, where smallpox was rife, it was received with great enthusiasm, religious processions being formed for the purpose of receiving "the blessed vaccine."

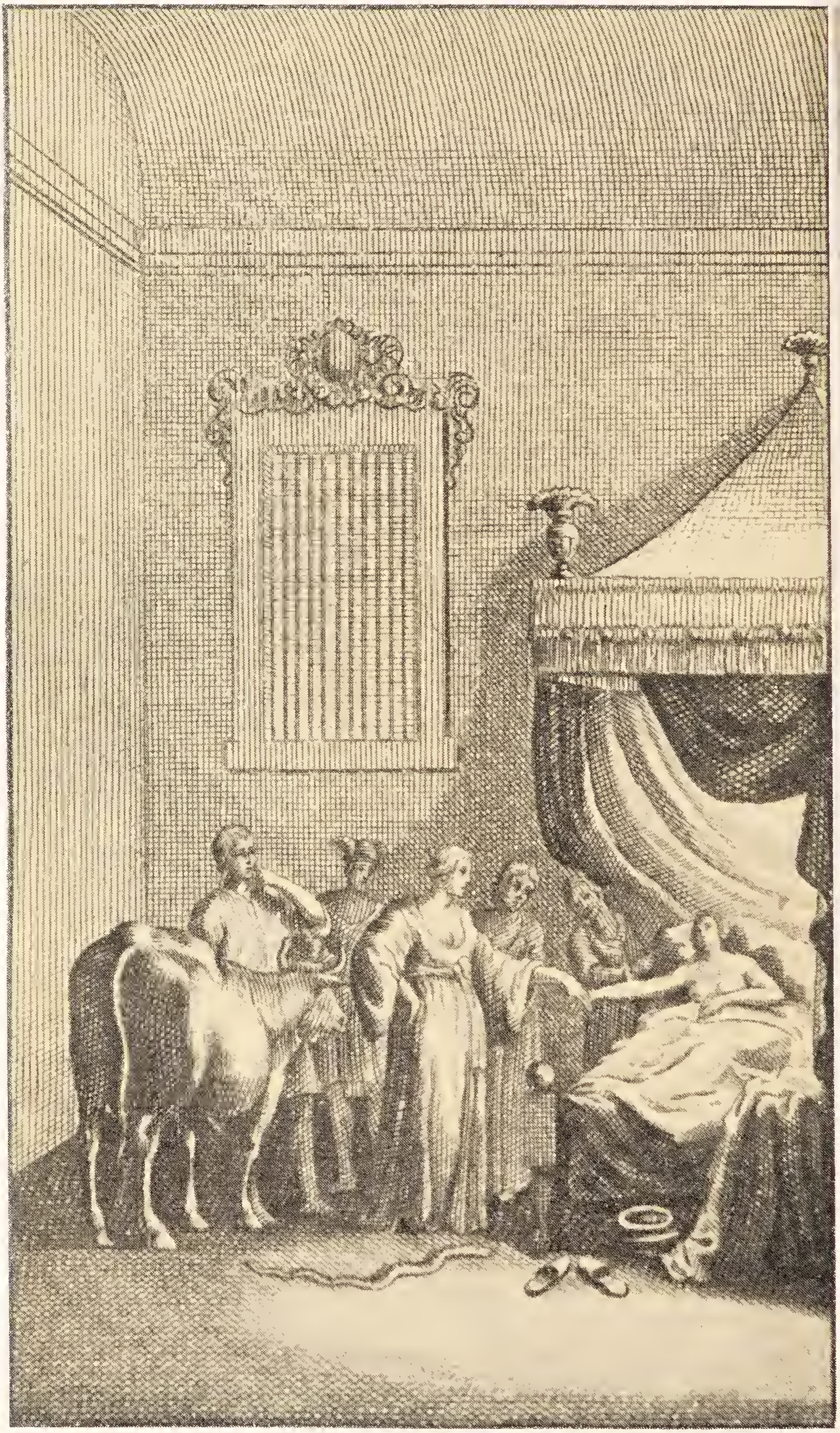
In Europe

In Italy, Jenner's discovery was successfully exploited by Sacco, of Milan, in 1801. He laboured with unwearied activity, becoming the director of vaccination, and in a few years he had vaccinated 20,000 people. For many of these the vaccine was obtained from an animal with natural cowpox which was discovered in Lombardy after a prolonged search.

In France, Valentin and Desoteux were the first to call attention to the subject, and the practice soon became popular. Liancourt established a Vaccine Institute by subscription, obtaining much financial support from Lucien Bonaparte, who was then Secretary of the Interior.

François Colon, a Paris physician, in order to encourage those who hesitated, had his own son, eleven months old, vaccinated. He also wrote and circulated widely a pamphlet in which he said:—

"I will inoculate gratuitously all the poor, all soldiers and their children, who have not had smallpox, on a simple letter of recommendation from beneficence committees, from different administrations and constituent bodies. I will entertain at my house and attend three intelligent nursing mothers with their



"THE BLESSINGS OF VACCINATION TO MAN"
From an engraving, 1800

children, during the whole period of inoculation. I invite all my colleagues to study my inoculations, and to be convinced by the testimony of their own eyes of the usefulness and advantages of vaccine. I shall be very pleased to enter into correspondence with all the doctors of provinces who wish to know and to propagate this method of inoculation. I will send them some virus vaccine which may be useful to them.

"In order to inspire the public with confidence, I will give to those who wish it a receipt for what I receive as my fees, with a promise to restore it at sight to those who suffer from smallpox after having been inoculated by me. As a guarantee of this promise, I will, if they wish it, sign a deed in the presence of a lawyer, with mortgage on an unencumbered real estate, binding me to refund in the above-mentioned case, as far as I shall be called upon to make good my promise."

Napoleon's soldiers vaccinated

In January, 1800, Jenner's Treatise was translated into French by the Count de la Roque, and, five years later, Napoleon demonstrated his confidence in Jenner's theories by ordering all soldiers who had not suffered from smallpox to be vaccinated.

The Empress of Russia is interested

Among the most enthusiastic supporters of Jenner's discovery was the Empress of Russia, who urged her subjects to be vaccinated, and who ordered that the first child who submitted to the operation should receive the name of "Vaccinoff," and be educated at the public expense. The young Vaccinoff, after vaccination, was conveyed to St. Petersburg in one of Her Majesty's Imperial coaches, and, after being educated in the Foundling Hospital, received a pension for life. The Empress, in commemoration, afterwards presented Jenner with a valuable diamond ring.

Meanwhile, Jenner's influence and popularity increased. The Emperor of Austria and the King of Spain, at his request, released Englishmen, who had

"Those doctors, those doctors! they see pretty arms, pretty shoulders, pretty . . . . And they make by it, too!"

From a French caricature by Lafosser

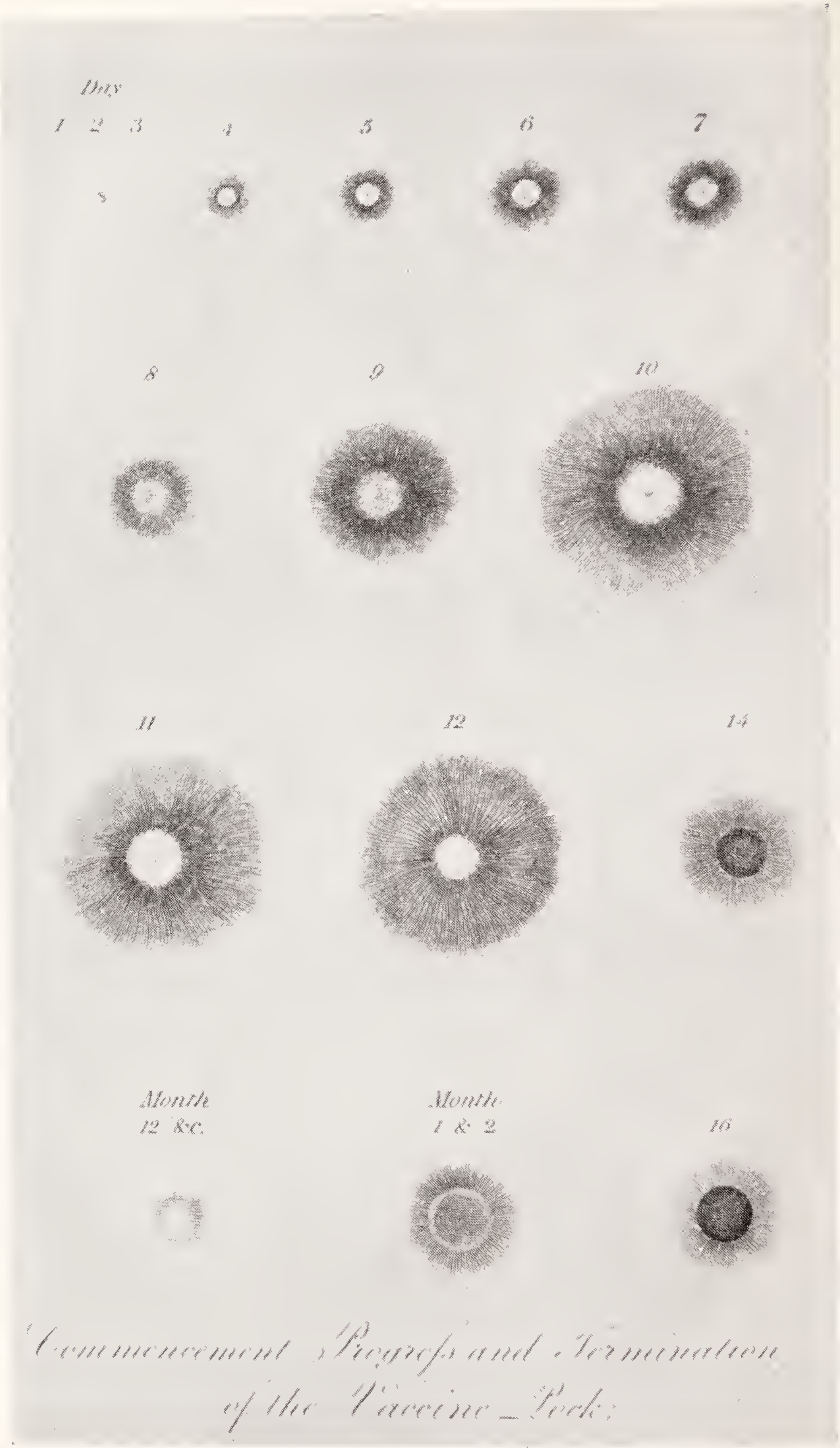
been taken in the wars. In France, where a Dr. Wickham remained a prisoner, Jenner was applied to by one of his friends to present a petition to Napoleon, soliciting the physician's liberation. He readily undertook the task, and drew up a petition to the Emperor at the time when he was exhibiting his greatest animosity towards Britain. The petition was forwarded and safely reached the Emperor. It happened to be handed to him when he was seated in his carriage, together with the Empress Josephine, waiting for the horses to be changed. Glancing at it, he exclaimed to the driver, "Away, away!" But the Empress, examining the paper, said, "But stay, you see from whom this comes—Jenner." Napoleon's manner changed immediately, and he replied, "What that man asks is not to be refused," and so Wickham was released. Napoleon liberated several other prisoners, and even whole families, from time to time, at Jenner's request, and it is stated that he never refused a petition sent by Dr. Jenner, such was the esteem in which he held him.

Prisoners of war released

Napoleon further issued a decree that a hundred thousand francs should be at the disposal of the Minister of the Interior for the propagation of vaccination.

During the years that Jenner had spent upon his research and inquiry, he had expended a considerable amount of money, hoping that his discovery might eventually recoup him and become a financial success. This becoming known to his friends, he was advised to apply to Parliament for a grant, and on December 9, 1801, he journeyed to London to frame a petition, for which he obtained a promise of assistance from Admiral Berkeley. The petition was laid before the House in the March of the following year, and was presented on the following grounds: First, that he had discovered that cowpox was inoculable from cow to

Parliamentary grant to Jenner



COMMENCEMENT, PROGRESS AND TERMINATION
OF THE VACCINE POCK

From the Report of the Royal Jennerian Society, 1816

man; second, that persons so inoculated were for life perfectly secure from smallpox. Jenner added that he had not made a secret of his discoveries, that the progress of smallpox had already been checked, and that he had been put to much expense and anxiety. The matter was referred to a Committee, and in June, 1802, the report was laid before the House, which ultimately granted ten thousand pounds to Jenner, who then left London for Berkeley.

The Royal Jennerian Society

Shortly afterwards, some of his leading supporters in London again took up the matter of forming a Jennerian Institution, for promoting universal vaccine inoculation. The Queen became a patron, the King granting permission for the society to be called "The Royal Jennerian Society for the Termination of the Smallpox," and an influential board of directors and a medical council were appointed. Jenner was made President, and Dr. John Walker appointed Resident Vaccinator. Thirteen stations were opened in London, and in eighteen months they announced that 12,288 inoculations had taken place, and 19,352 charges of cowpox virus had been supplied to different parts of the British Empire and foreign countries. But although the Institution began well, in less than six years its success was on the wane. Jenner disagreed with the chief vaccinator, who resigned his office, and in 1808 the Society practically collapsed. Meanwhile, Jenner had decided to take a practice in London, and for some years settled in Hertford Street, Mayfair. But the results were far from satisfactory, and, after a trial, he returned to his native village. In a letter to one of his friends, referring to the matter, he says, "I have now completely made up my mind with respect to London. I have done with it, and have again commenced the village doctor. I found my purse not equal to the sinking of the thousand pounds annually (which has actually been the case for several successive years), nor the gratitude of the public deserving such a sacrifice. How hard, after what I have done, the toils

"EFFECTS ARISING FROM VACCINATION"
From a caricature, 1806

I have gone through, and the anxieties I have endured in obtaining for the world a greater gift than man ever bestowed on them before (excuse this burst of egotism), to be thrown by with a bare remuneration of my expenses."

Doubts and difficulties

In the year 1804, failures of the new inoculation multiplied considerably, and even some of Jenner's best friends began to lose confidence. His time at Berkeley was largely taken up in replying to correspondents, and in endeavouring to account for the numerous failures. Jenner had been always aware that smallpox had occurred after vaccination, but that if it did occur he believed that vaccination could not have been properly performed.

He still continued to vaccinate all the poor who applied to him on certain days, so that he had sometimes as many as three hundred persons waiting at his door.

Criticism and caricature

Notwithstanding the success and support that vaccination was now receiving in all parts of the world, there were many who still opposed the practice, and pamphlets, lampoons and caricatures were constantly published by the anti-vaccinators. It was actually alleged by some that those inoculated by cowpox would assume the bovine features of the animals themselves. A Dr. Rowley wrote a long treatise entitled "Cowpox Inoculation no Security against Smallpox Infection; to which are added the Modes of treating the Beastly New Diseases produced from Cowpox." The work is illustrated by the picture of "a cow-poxed ox-faced boy." "Various beastly diseases," asserts the writer, "common to cattle have appeared among the human species since the introduction of cowpox—cowpox mange, cowpox abscess, cowpox ulcer, cowpox gangrene, cowpox mortification, and enormous hideous swellings of the face, resembling the countenance of an ox with the eyes distorted and eyelids forced out of their true

situation. Smallpox is a visitation from God, but the cowpox is produced by presumptuous man; the former was what Heaven ordained, the latter is perhaps a daring violation of our holy religion."

Another writer on the subject recounts the story of a lady who complained that "since her daughter was inoculated, she coughed like a cow, and has grown hairy over her body."

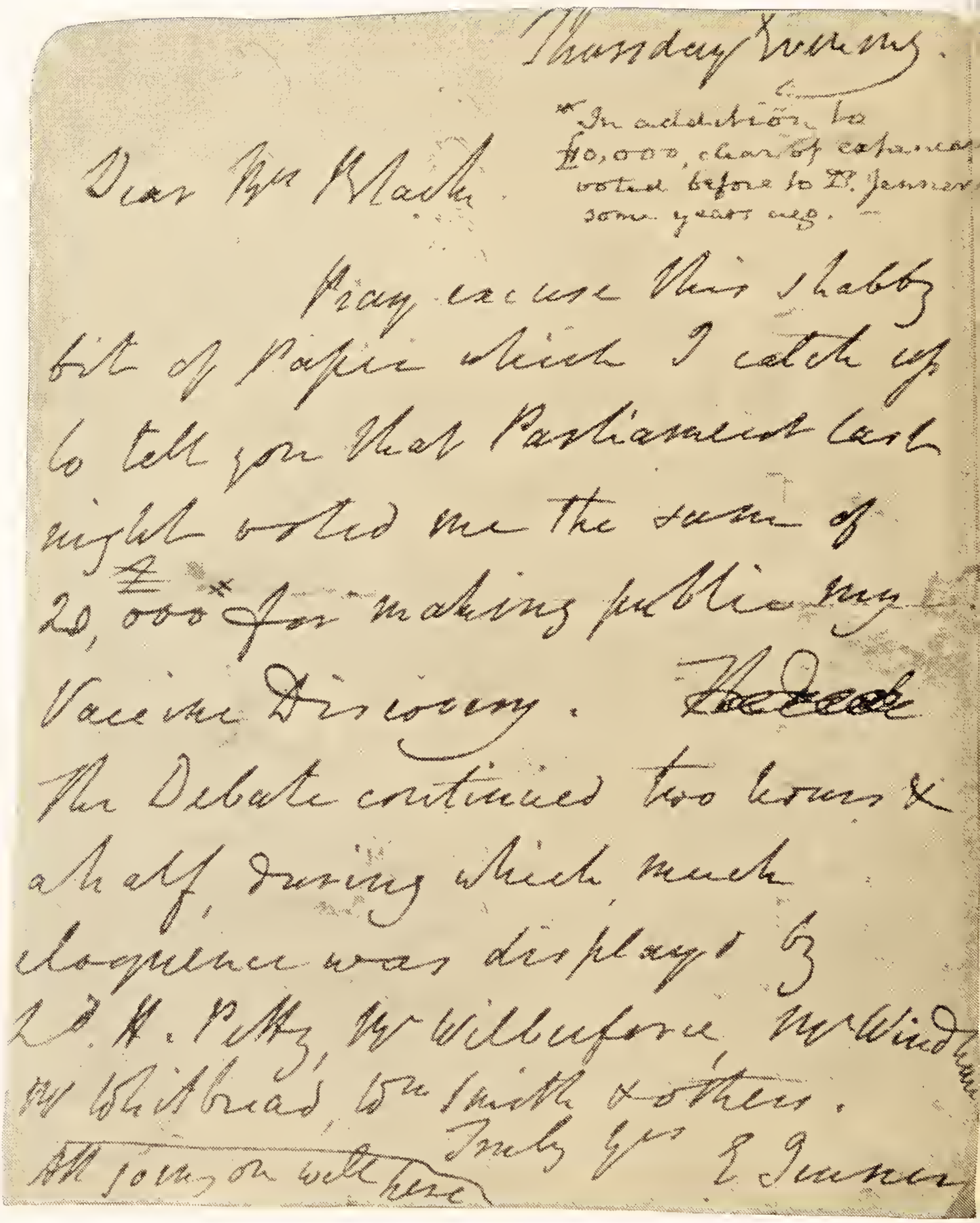
Another anti-vaccinationist declared that the inoculation of the cowpox had been discontinued in a part of the country in which he had been staying, because those who had been inoculated in that manner "bellowed like bulls."

It was stigmatised by others as the "damnest thing ever proposed," and "the most degrading relapse of philosophy that ever disgraced the civilised world."

Honours for Jenner

But, notwithstanding these fulminations, vaccination made steady progress, and every country vied in honouring its discoverer. Jenner was elected a member of nearly all the leading scientific societies in Europe. He was presented with the Freedoms of the Cities of London, Dublin, Edinburgh and Glasgow, and the Medical Society of London conferred on him a gold medal at their anniversary festival, when Dr. Lettsom delivered an oration on vaccination. In 1812, at Berlin, the anniversary of cowpox inoculation was celebrated by a Jennerian feast, and addresses and diplomas poured in upon the discoverer from all parts of the world. The following quaintly worded address was sent to him by the Red Indians of North America:—

"Brother! Our Father has delivered to us the book you sent to instruct us how to use the discovery which the Great Spirit made to you, whereby the smallpox, that fatal enemy of our tribe, may be driven from the earth. We have deposited your book in the hands of a man of skill whom our Great Father employes to attend us when sick or wounded. We shall not fail to teach our children to speak the name of Jenner,



Thursday Evening.

Dear Mrs Black

*In addition to £10,000, clear of expences voted before to Dr. Jenner some years ago.

Pray excuse this shabby bit of Paper which I catch up to tell you that Parliament last night voted me the sum of £20,000* for making public my Vaccine Discovery. ~~The deb~~ The Debate continued two hours & a half during which much eloquence was display'd by Ld. H. Petty, Mr Wilberforce, Mr Windham, Mr Whitbread, Wm Smith & others.

Truly Yrs E Jenner

All going on well here

FACSIMILE OF ORIGINAL AUTOGRAPH LETTER WRITTEN BY DR. JENNER TO MRS. BLACK, INFORMING HER THAT PARLIAMENT HAD VOTED HIM £20,000

and to thank the Great Spirit for the bestowing upon him so much wisdom and so much benevolence. We send with this a belt and string of wampum in token of our acceptance of your precious gift, and we beseech the Great Spirit to take care of you in this world, and in the land of spirits."

A grant of £20,000

In July, 1806, the subject of vaccination was again brought before the House of Commons, and the question was considered whether a sufficient reward had been bestowed on the original discoverer of vaccine inoculation. The matter was referred to the Royal College of Physicians, and, having conferred with the other medical faculties in Scotland and Ireland, they reported in favour of a further grant being made to Dr. Jenner, with the result that it was agreed to present him with twenty thousand pounds.

The Government having decided to support vaccination, they felt called upon to found an establishment to carry on the work of the Royal Jennerian Institution, and Jenner was asked to draw up a plan and to prepare an estimation of the cost. The illness of his son necessitated his return to Berkeley, but the warrant for instituting a national vaccine establishment was obtained in his absence, and he was appointed director.

Dissensions, however, crept in at the outset, which ended in Jenner's resigning his post as director, although he continued to give the Institution the benefit of his advice when it was needed.

In 1810, many domestic trials came upon him. The death of his son distressed him so deeply that it materially affected his health. He went to Bath to endeavour to recruit, and on his return he was called upon to attend the Earl of Berkeley, and visited him up to the time of his death. The following year he lost his sister, which was also a great grief to him.

On May 26 in the same year, while in London, he was summoned to attend the bedside of the Hon. Robert Grosvenor, who had developed a

serious attack of smallpox. He had been vaccinated by Jenner ten years previously. In four days he became delirious, and the worst symptoms manifested themselves in a very short time. Attended by Sir Henry Halford, Sir Walter Farquhar, and Jenner, he recovered, although a fatal termination had been regarded as inevitable. This case served to revive the agitation against vaccination, and caused quite a panic amongst those who had had their children vaccinated. A fresh outburst of criticism, together with a summons to give evidence before the House of Lords on the Berkeley peerage, seems to have greatly unnerved Jenner, and aged him considerably.

Vaccinated patient seriously attacked

In 1814, he visited London for the last time, when he was presented to the allied sovereigns and the Emperor of Russia on the occasion of their visit to London. The Grand Duchess of Oldenberg, the sister of the Emperor, was very desirous that Jenner should be introduced to His Majesty, and an interview took place. Alexander conversed with him on the astonishing effects of vaccination in Russia, which he declared "had nearly subdued smallpox throughout that country." Jenner replied that he had the highest gratification upon hearing such an important fact from his Majesty. The doctor then presented the monarch with a volume of his own works, which he graciously accepted. A few days afterwards Count Orloff waited on Jenner, and asked him if a Russian order would be acceptable to him, but Jenner replied that he thought this exclusively belonged to men of independent means. The Count expressed his surprise, and Jenner respectfully declined the honour. A little later he had an audience with the King of Prussia, who gave him a pressing invitation to visit Berlin.

Jenner's last visit to London

In the year following he lost his wife, after a long illness, and, stricken with grief, he retired to Berkeley, which place he did not leave again, except for a day or two, until his death.

On January 23, 1823, he wrote in his last letter to his friend Gardner. "I have had an attack from a quarter I did not expect, the *Edinburgh Review*. These people understand literature better than physic, but it will do incalculable mischief. I put it down at one hundred thousand deaths at least. Never was I involved in so many perplexities."

The following day he retired to rest, apparently in his usual health, and the next morning rose and came down to his library, where he was stricken with an attack of apoplexy and paralysis of the right side. He never rallied, and died the following morning, January 26, 1823.

Jenner's death

In estimating Jenner's great achievement it should be remembered that his discovery was not so much the fact that persons who had been infected with cowpox escaped variola, but that the matter taken from a human being suffering from cowpox had the power of *protecting another individual* from smallpox.

Jenner's achievement

The lives that this discovery has been instrumental in saving are the most eloquent tribute to his memory, and the principles that he advocated and put in practice still remain the one efficient means of protection against one of the most dreaded scourges that afflict mankind.

It has been well said, that the brilliant discoveries that have since been made in the field of protective inoculation have added lustre to his fame, and his name will ever be remembered as that of one of humanity's greatest benefactors.

"THE ORIGIN OF VACCINATION"

CHAPTER VI

The Progress of the Principles of Vaccination and Inoculation

Many years elapsed before Jenner's principles of vaccination were applied to other diseases. This began with the study of fermentation, the foundation and development of bacteriology.

In 1838, De La Fonde, a Professor at the Alfort Veterinary School, pointed out to his students "little rods," as he called them, which he found in the blood of animals that had died from anthrax, an observation which was destined to have far-reaching results.

Following this, Henle, in 1841, came to the conclusion, on purely theoretical grounds, that the cause of some diseases must be living organisms, and, by a similar induction, Farr applied the word "zymotic" or "fermentive" to them, a term which was soon almost universally adopted.

Micro-organisms and disease

In 1849, Pollender and Brauell also noted certain micro-organisms in the blood of anthrax victims, but it was not until 1861 that these bodies were studied by Davaine, who, describing the thread-like corpuscles which he had seen in the blood of sheep attacked by anthrax, declared: "In the present state of science, no one would think of going beyond these corpuscles to seek for the agent of contagion. This agent," he stated, "is visible, palpable; it is an organised being endowed with life, which is developed and propagated in the same manner as other living beings. By its presence, and its rapid multiplication in the blood, it without doubt produces in the constitution of this liquid, after the manner of ferments, modifications which speedily destroy the infected animal."

Further investigations proved the correctness of Davaine's theory, viz., that most forms of contagious disease were the result of fermentative processes,

LOUIS PASTEUR

Born 1822. Died 1895

analogous in all respects to the fermentation which takes place in wine or beer.

It is very largely to the brilliant researches of Louis Pasteur, and his investigations into the causation of disease, that we owe the foundation of the scientific era of inoculation which produced such remarkable developments in recent times. Born on December 27, 1822, at Dôle, in France, he was the son of a tanner who carried on business in that town. He was sent for a short time to a boarding school in Paris, and afterwards to a college at Arbois, where his father hoped he would eventually become professor. In 1842, he took his degree as Bachelor of Science at Dijon, and afterwards went to Paris to attend classes at the Sorbonne, where he studied under the celebrated Dumas. In 1848, he was appointed Professor of Physics at Dijon, and six years later became Professor and Dean of a new faculty of science at Lille, where he commenced his famous researches on fermentation which led to such important after results. In 1865, he was sent, on the recommendation of Dumas, to Alais, to investigate the silk-worm disease, which had seriously affected the silk industry of France. This he brought to a successful conclusion.

Pasteur and his work

In 1877, he began to investigate anthrax, or charbon. This mysterious scourge was then causing terrible ravages among sheep in France, and animals stricken down by the disease died within two hours.

The starting-point of Pasteur's investigation of anthrax was, that not only fermentatives, but also disease processes, were due to the action of bacteria. He declared that anthrax was due to this cause, and set out to prove that it was possible to modify the virulence of a pathogenic organism by artificial means, so that it no longer produced fatal results, and that this attenuated virus protected against the fatal form of the disease.

Early results in anthrax

DR. CHAMBERLAND

In the summer of 1879, Pasteur interrupted his researches on anthrax to investigate a sudden epidemic that had broken out in the farmyards of France, known as chicken cholera.

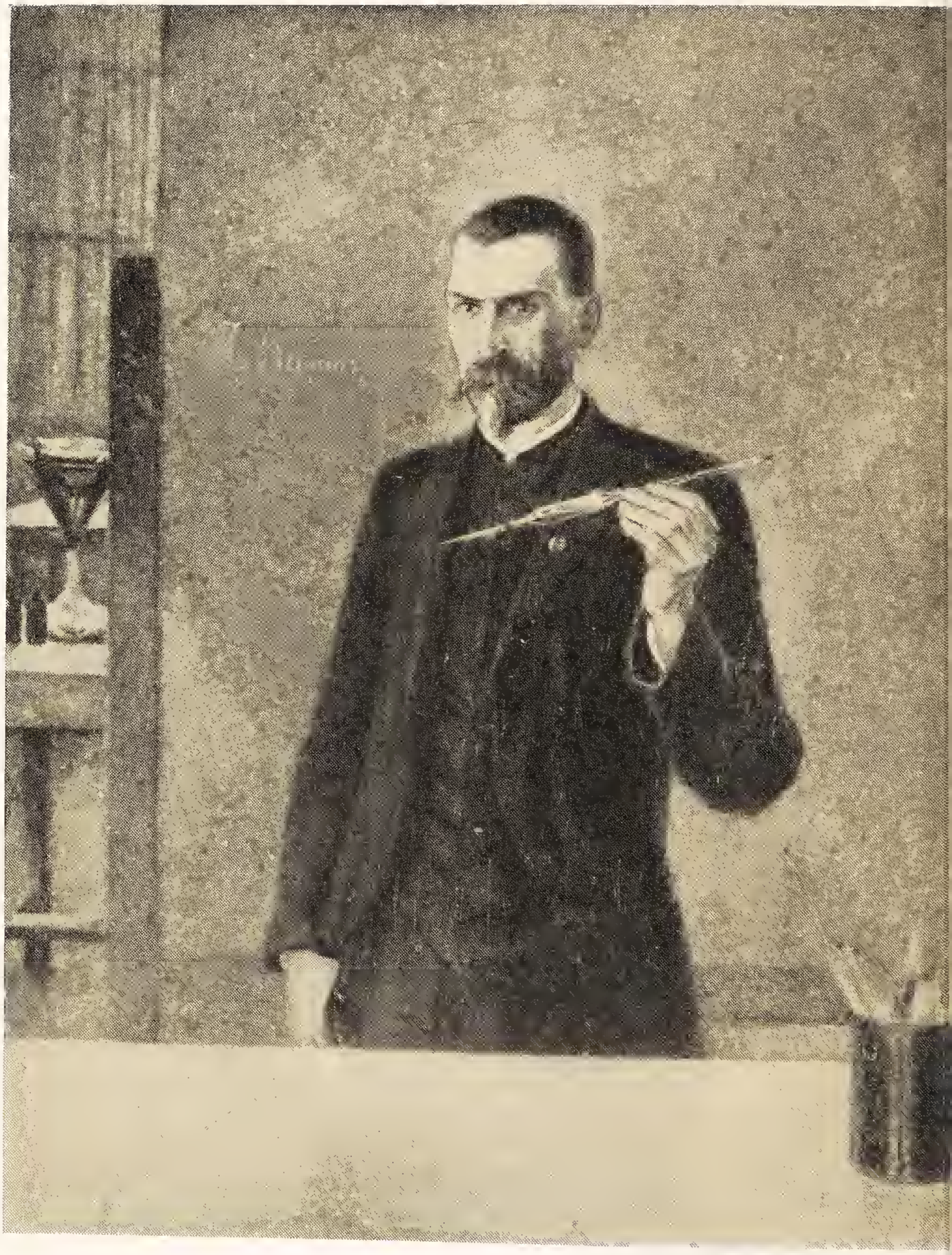
As far back as 1869 Moritz, an Alsatian veterinary surgeon, suspected that this disease was caused by some micro-organism, and nine years afterwards Perroncito made a drawing of an organism which he discovered in a fowl that had died from the disease. Toussaint studied it, and demonstrated that this microbe was indeed the cause of virulence in the blood, and sent the head of a cock that had died of chicken cholera to Pasteur.

The microbe of chicken cholera

Pasteur at once began an investigation of the subject, and discovered that a micro-organism was the specific cause of the disease. He further found that it could be propagated outside the fowl's body in sterilised material, and after two generations of such cultures the virus did not lose its specific character or intensity if each culture was made from the preceding one at short intervals. If a few days were allowed to elapse, he noted that the virus became weaker, and it could then be obtained of various degrees of virulence, some fatally strong, others so attenuated that a bird inoculated with it had a slight illness only, but this trifling effect protected it against subsequent inoculation with the stronger virus. His further researches showed that the virus could be cultivated of each degree of intensity without altering its strength, that the weakest could be cultivated as well as the strongest, and that of any intermediate strength equally; they threw an entirely new light on certain phenomena, and paved the way to his further remarkable discoveries.

Inoculation with attenuated virus

In 1881, he resumed his search into the cause of anthrax, and in February he was able to announce his discovery of a vaccine to protect animals against



DR. ROUX

that disease, which aroused considerable interest throughout Europe.

The Melun Agricultural Society hastened to give the scientist facilities to prove his assertions, and invited Pasteur to organise public experiments on his method of preventive vaccination for anthrax in the neighbourhood of Melun, Fontainebleau and Provins.

First public experiments with anthrax vaccine

Pasteur accepted the proposition, and the Melun Agricultural Society put sixty sheep at his disposal, twenty-five of which were to be vaccinated by two inoculations at twelve or fifteen days' interval, with some attenuated anthrax virus. Some days later these twenty-five, and also twenty-five others, were to be inoculated with some very virulent anthrax culture. "You will see," wrote Pasteur with confidence, "the twenty-five unvaccinated sheep will all perish, and the twenty-five vaccinated ones will survive."

On May 5, 1881, the day appointed for the test, Pasteur, accompanied by his assistants Chamberland and Roux, whose names have since become famous in the world of science, arrived at the farm Pouilly-le-Fort, near Melun, where a great throng of physicians, apothecaries, veterinary surgeons and agriculturists had assembled. The sheep to be vaccinated and those left unvaccinated for the test were separated under a large shed, and each of the former received an injection consisting of five drops of the bacteridium culture, which Pasteur called the first vaccine, on the inner surface of the right thigh, by means of a small Pravaze syringe. A second inoculation was not made till a fortnight afterwards, with a vaccine which, though still attenuated, was more virulent than the first. On the last day of the month the third and last inoculation, with very virulent anthrax culture, took place, this time on fifty sheep and ten cows, vaccinated and unvaccinated. Pasteur, writing to his son-in-law, said: "On June 5 at the latest, the final result will be known, and that should be twenty-five survivors out of

twenty-five sheep and six cows. If this success is complete this will be one of the finest examples of applied science in this century, consecrating one of the greatest and most fruitful discoveries."

The result was in every way satisfactory, as Pasteur had predicted. The sheep that had been originally vaccinated remained alive, while the unvaccinated ones died.

On June 13, Pasteur communicated the result of this great control experiment to the Académie des Sciences, and said: "We now possess virus vaccine of anthrax capable of preserving those inoculated from the dread disease, without being in itself deadly."

The French Government, desirous of recognising his discovery, offered him the Grand Cordon of the Legion of Honour, but Pasteur would only accept it on the condition that his able assistants, Roux and Chamberland, were to share in the honour, and to this stipulation the Government acceded.

Before even the completion of the discovery of the anthrax vaccine the great scientist had embarked on an investigation of still greater importance, namely, that into the cause and prevention of hydrophobia.

The subject of this dread disease, which goes back to a period of great antiquity, was one which has baffled scientific investigation throughout the centuries.

Hydrophobia in antiquity

Celsus described it in Roman times, and remarked on the patient being tortured at the same time by thirst and an invincible repulsion towards water. He recommended suction of the bitten part by means of a dry cupping glass, and afterwards the application of the actual cautery, or of strong caustics, a method of treatment which remained in vogue down to the nineteenth century. Galen also described the disease, and recommended the excision of the wounded part as the chief protective treatment. In the Middle Ages

certain Saints, such as St. Hubert in Belgium, were supposed to effect miraculous cures, and sea-bathing, or the throwing of the patient into a lake or pond, was supposed to effect a cure.

In 1780, a prize was offered for the best method of treating hydrophobia in France, and it was awarded to Surgeon-Major Leroux, who wrote a dissertation recommending cauterisation as the best means of treatment. All methods and remedies, however, proved unavailing, and down to the latter part of the nineteenth century, hydrophobia was regarded as hopelessly incurable, and the mortality from rabies was gradually increasing. Practically every person in whom the symptoms of hydrophobia were once developed, might be regarded as condemned to death without hope of a reprieve.

Leroux's method of treatment

Pasteur's attention was first drawn to the subject in 1880, by Bourrel, an old army veterinary surgeon, who had long been trying to discover a remedy for the disease. He had suggested, as a preventive measure, that the teeth of dogs should be filed down so that they could not bite into the skin.

Bourrel kept a number of animals in kennels, and two suffering from rabies he brought to Pasteur's laboratory. On December 10 of the same year, while Pasteur was still planning his investigations, he was notified by Professor Lannelongue that a little child, five years of age, who had been bitten by a dog on the face a month before, had been admitted to the Hôpital Trousseau, with symptoms of hydrophobia. The child died after twenty-four hours of horrible suffering, suffocated by the mucus which filled the mouth. Pasteur seized the opportunity, and, hurrying to the hospital with all speed, collected some of this four hours after the child's death. Adding a small quantity of water to the mucus, he inoculated some rabbits with the liquid, and they died in less than thirty-six hours.

Pasteur's experiments commence

"SERUM DIRECT FROM THE HORSE, FRESHLY SUPPLIED"

The saliva from these he injected into other rabbits, who succumbed almost immediately. On examining the blood of the latter under the microscope, he discovered a micro-organism, which he cultivated in veal broth, and then inoculated rabbits and dogs with the culture. After their death, a microscopical examination of the blood revealed the same organism.

Following these experiments he made several attempts to inoculate rabies direct to other rabbits through the medium of the saliva of a mad dog. The great danger involved in carrying this out can be imagined from the description given of the following scene. On one occasion two assistants at Bourrel's kennels undertook to drag a mad bulldog suffering from rabies, and foaming at the mouth, from the cage in which it was kept. They seized it by means of a lasso, and, stretching it on a table, held the struggling and ferocious animal down while Pasteur, with undaunted courage, drew off a few drops of the deadly saliva by means of a glass tube held between his lips.

But uncertainty still followed the inoculations even of this medium, and the incubation was very slow, so that some other means, which would be more rapid and certain, were sought for. Roux, from observation of several rabid animals in the laboratory, concluded that the mad fury of a rabid dog excited the grey cortex of the brain, and mentioned the same to Pasteur, who decided to follow the matter up. On making the next post-mortem on a mad dog, he uncovered the brain, and with a sterilised tube removed a particle of the substance, which he mixed with sterilised water. With this liquid he inoculated several animals, who rapidly succumbed to hydrophobia, and from this experiment he concluded that the seat of the rabid virus was not in the saliva only, as it was previously thought to be, but was also in the brain. He resolved to confirm this by a long series of experiments, and on the termination of these he decided to submit his results to be verified

Hydrophobia and the grey cortex

by a Commission. This was duly constituted by the French Government, in May, 1884, and a plan of work was immediately formulated. A large number of dogs were submitted to control experiments, which were continued for several months, and in August of the same year the Commission reported to the Minister of Public Instruction that the first series of experiments had been carried out with the most satisfactory results, and they desired that further research might be prosecuted on a larger scale. This was agreed to, and a suitable place was found in the Park Villeneuve l'Etang, near St. Cloud.

On March 28, 1885, Pasteur, writing to a friend, states, "I shall be busy for some time, settling down, or rather settling my dogs down, at Villeneuve l'Etang. I also have some new experiments on rabies in hand, which will take some months. I am demonstrating this year that dogs can be vaccinated or made refractory to rabies, after they have been bitten by mad dogs. I have not yet dared to treat human beings after bites from rabid dogs; but the time is not far off, and I am much inclined to begin by myself—inoculating myself with rabies, and then arresting the consequences; for I am beginning to feel very sure of my results."

Kennels established at Villeneuve l'Etang

In May everything was ready at Villeneuve l'Etang for the reception of sixty dogs, where they were accommodated in immense kennels. Besides this, forty other dogs were under experiment at Rollin, and fifteen others at Bourrel's. Two series of experiments were then carried out on these animals, the first consisting in making the dogs refractory to rabies by preventive inoculation and the second in preventing the onset of rabies in dogs bitten or subjected to inoculation. But months went by without bringing about any satisfactory conclusions.

The matter was brought to a crisis by an unexpected incident. On July 6, 1885, a little boy named

Joseph Meister, nine years of age, was brought to Pasteur's laboratory by his mother. He had been terribly bitten two days before by a mad dog at Meissengott. The wounds had been cauterised by a local doctor, who had advised the mother to bring her child to Paris. Pasteur was torn by conflicting emotions, and the sight of the child, who suffered so much that he could hardly walk, caused him to decide that something should be done. He made arrangements for the comfort of the poor mother and her son, and told them to see him again at five o'clock, Meanwhile, he communicated with his colleagues. Vulpian and Grancher, and they came to the laboratory that evening and examined the boy's wounds, some of which were very deep. In the end they concluded to inoculate the boy immediately. The liquid chosen was fourteen days old, and had quite lost its virulence, and was prepared from some fragments of medulla oblongata. Pasteur had a bedroom prepared for the mother and child close at hand, and the little sufferer soon became happy with the many animals that the scientist kept about the place for experimental purposes. The first inoculation was followed by others, gradually increasing in strength. "All is going well," wrote Pasteur, on July 12, "the child sleeps well, has a good appetite, and the inoculated matter is absorbed into the system from one day to another without leaving a trace. It is true that I have not yet come to the test inoculations which will take place on Tuesday, Wednesday and Thursday. If the lad keeps well during the following three weeks, I think the experiments will be safely concluded." Thus, for days, Pasteur became a prey to anxiety, going through in succession hopes, fear and anguish in his desire to save the child from a terrible death. His wife states he could no longer sleep, visions came to him of this child struggling in the last mad paroxysms of hydrophobia. At length the treatment was complete, and Pasteur, yielding to persuasions to take a rest, left the boy in the hands of Grancher

Boy inoculated

for a short time, and went into the country, where he lived in constant expectation of the daily report from Paris. But these were all favourable, and the boy seemed to be completely well.

On October 21, Pasteur made his statement on the ease before the Académie des Sciences. By this time three months and three days had passed, and no ill had resulted to the child.

Success reported to the Académie des Sciences

Bouley, at this historie meeting, remarked, "We are entitled to say that the date of the present meeting will remain for ever memorable in the history of medicine, and glorious for French science; for it is one of the greatest steps ever accomplished in the medical order of things—a progress realised by the discovery of an efficacious means of preventive treatment for a disease, the incurable nature of which was a legaey handed down by one century to another. From this day, humanity is armed with a means of fighting the fatal disease of hydrophobia and of preventing its onset. It is to M. Pasteur that we owe this, and we could not feel too mueh admiration or too much gratitude for the efforts on his part whieh have led to sueh a magnificent result."

Directly Pasteur's great discovery was made known, people who had been bitten by rabid dogs hastened to Paris from all parts of Europe, and a regular hydrophobie service was rapidly organised. Physieians came from all parts of the world, asking to be allowed to study the details of the method. Pasteur took a personal interest in each of his patients, and children especially inspired him with a loving solicitude.

Commission appointed

The Académie des Scienees appointed a Commission, which unanimously adopted the suggestion that an establishment for the preventive treatment of hydrophobia should be instituted in Paris, whieh resulted in the ereetion of the Pasteur Institute, in the Rue Dutot,

which was opened by President Carnot in November, 1888. This great dispensary for the treatment of hydrophobia has since become a centre of research and teaching on virulent and contagious diseases.

The example was followed in several other countries, and by May, 1889, there had been established seven anti-rabic institutions in Russia, five in Italy, one in Constantinople, one in Barcelona, one in Bucharest, one in Rio de Janeiro, one in Havana, one in Buenos Aires, one in Mexico, and one in Vienna.

Pasteur's discovery was investigated and confirmed by a Commission appointed by the British Government in 1886 to study and verify the facts. After fourteen months' investigation of the prophylactic method, they reported of the new method of inoculation or vaccination discovered by Pasteur, that it would be difficult to over-estimate its utility both from the point of view of its practical side and of its application to general pathology.

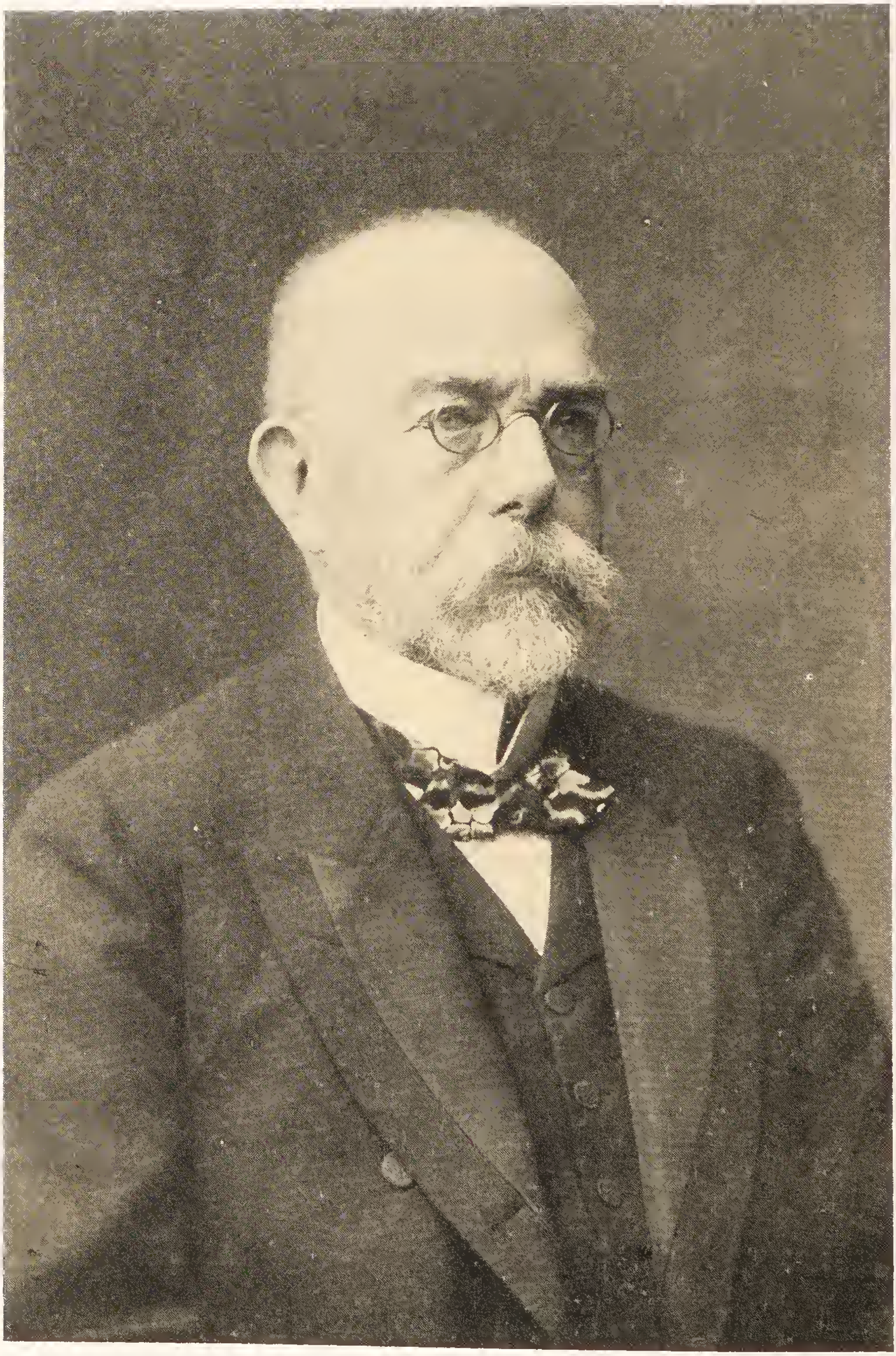
Some statistics of anti-rabic inoculation

Some idea of the value of the treatment may be gathered from the following: Since anti-rabic inoculation was first performed (July 6, 1885) up to May 21, 1889, 6,870 persons were treated at the Institut de Paris alone. Dr. Roux stated, in a lecture delivered before the Royal Society of London on May 23, 1889, that, on an average, since 1885, about a hundred and fifty persons came each month to the laboratory to be inoculated. The injections were made, he stated, in the side, the right and left alternately; they were repeated for fifteen days. For ordinary bites, the injections commenced with medulla dried for fourteen days, and stopped with that dried for three days. In cases which were more serious, a greater number of injections were made, and the recent medullas were arrived at sooner, as a more active treatment was necessary against such bites.

But, with the conclusion of his great discovery in connection with rabies, Pasteur's labours were not

yet ended, and, in spite of his failing strength, in conjunction with Roux and Yersin, researches had already been commenced in his laboratory on diphtheria, which were to lead to brilliant results in the future.

Towards the close of 1895, Pasteur was seized with a serious illness, which caused the greatest anxiety to his family and friends. Although an improvement took place for a short time, he never thoroughly recovered, and on September 28, 1895, he passed away at Villeneuve l'Etang, near the scene of his triumphant discoveries.



Robert Koch
Born 1843 Died 1910

CHAPTER VII

Bacteriology, and its Influence on Preventive Medicine

Few men have done more in laying the foundation of the problems associated with immunity and the prevention of disease than Robert Koch, who was the first also to demonstrate the transmission of infectious diseases artificially from animal to animal, from which method such great results have been achieved in recent years.

He was born on December 11, 1843, at Klausthal, in the province of Hanover, and, after finishing his academic career, and taking his degree in medicine, he became an assistant in the General Hospital in Hamburg. Afterwards he became physician to the Asylum for Idiots in Langenhagen, near Hanover, until 1868. He then took up private practice for a time, and after going through the Franco-Prussian War as a surgeon, became district physician in the town of Wollstein. Here he fitted up a laboratory, and commenced to devote all his spare time to the study of the diseases of animals in the district in which he lived. Anthrax was one of the earliest diseases in which he interested himself, and it was his ambition to completely work out the life-cycle of the anthrax bacillus. The results of his research were published in 1876, when he set out the etiological relationship of the bacillus of anthrax to the disease, and by this paper, which has become one of the great classics of bacteriology, he threw the first clear light on the obscurity which at that time enveloped the world of micro-organisms.

Robert Koch

Koch's work on anthrax was accepted everywhere in Germany, but was opposed in France by Paul Bert. Bert's opposition induced Pasteur to take up the study of anthrax. He confirmed Koch's observations, and eventually, as already stated, brought the matter to a practical and satisfactory conclusion.

Koch then, with characteristic doggedness and energy, set himself to work to improve the methods and technique of bacteriology, and to him we owe many of the most useful discoveries in that branch of science. He devised most of the best methods for sterilisation and disinfection, and suggested many improvements in methods of work. Perhaps his greatest achievement may be said to be his poured-plate method for the isolation of organisms in pure culture. Up to this time no method had ever been devised for obtaining pure cultures of organisms from mixtures. He watched with minute care the development of the bacteria under the microscope, rejecting as worthless any preparations which showed extraneous organisms, and controlling his work by constantly producing the disease by inoculation. To obtain his pure cultures he employed nutrient gelatin, which he used in such proportions as to give a solid coagulum when cool, and added to this gelatin meat infusion to furnish a nutrient medium for the growth of organisms. His method of making streak cultures and of pouring plates gave pure cultures, and solved a problem which had been attempted by so many of his predecessors, and which gave greater impetus to the advancement of bacteriology as a science.

Koch's bacteriological work

He demonstrated the parasitic nature of infectious diseases, and the methods of cultivating pathogenic bacteria outside the body were brought by him to a high degree of perfection. In this way a systematic study of the cause of a disease became possible, and the means of combating its action determined by experiments.

Koch eventually removed to Berlin, and devoted himself exclusively to laboratory work. In 1882, he set to work to elucidate the etiology of tuberculosis, which he succeeded in proving to be due to the tubercle bacillus. To demonstrate this he devised a new method of staining, by means of which he could

Etiology of tuberculosis

differentiate between the organisms always present in tuberculous regions and those accidentally found there. He finally succeeded in cultivating the organisms he had stained, on solidified blood serum, and proved their relation to the disease by inoculation experiments on rabbits and guinea-pigs.

In 1890, he described the preparation of tuberculin, which was at once hailed throughout the world as the great specific for tuberculosis. Unfortunately, on trial it did not prove the success anticipated, and its failure for some time detracted from Koch's reputation. Physicians and patients suffering from the disease flocked from far and near to Berlin in the hurry to obtain even the smallest quantity of the remedy, and the use of this potent product, given indiscriminately in too large doses by inexperienced men, was followed by disastrous results.

Preparation of tuberculin

Improved methods of preparation have since been devised and exact knowledge has been gained, so that tuberculin has again come into extensive use both therapeutically in cases of tuberculosis and as a means of diagnosis in testing human beings or animals for the existence of the disease.

The later years of Koch's life were devoted to the investigation of tropical diseases, and the study of malaria. For this purpose he travelled through South Africa and German East Africa, and was in charge of the sleeping sickness commission sent out by Germany in 1906.

He died on May 27, 1910, working in the institute where he laboured daily, almost up to the last.

"THE COWPOX SWINDLE" (DER KUHPOCKEN SCHWINDEL)

CHAPTER VIII

THE MODERN DEVELOPMENT OF INOCULATION AND SERUM TREATMENT

Only the briefest summary is possible of the enormous development of prophylaxis and treatment by specific inoculation, since the new era of exact bacteriology was inaugurated by the researches of Pasteur, Koch, and their immediate followers. It may be stated that, apart from theoretical investigation of the mechanism of the immune reaction, practical progress has been made along two distinct lines. Pasteur's method of inoculation with an attenuated culture or virus, as described in a previous chapter, was directed to the active immunisation of the patient, and this is the basis of the various forms of protective or therapeutic inoculation or "vaccination" in use at the present day, whether the inoculum or vaccine consists of a living culture of modified virulence, a suspension of the killed organisms, or a solution of the soluble toxic substances which the organisms produce in artficial fluid media. As an example of the use of a culture of modified virulence may be mentioned Ferran's and Haffkine's prophylactic vaccines against cholera and Strong's similar vaccine for plague. Killed cultures are used prophylactically in Kolle's cholera and Haffkine's plague vaccine. Wright was responsible for the first systematic use of a killed suspension of typhoid bacilli as a protective inoculation against enteric fever, and, largely owing to the advocacy of the same observer, analogous killed cultures have acquired an important position in the prophylaxis and treatment of almost all infections which can be definitely associated with a known type of organism. Active inoculation of the patient with soluble toxic substances produced in artificial culture is an important factor in the therapeutic use of the tuberculins.

Methods of immunisation compared

W. M. HAFFKINE

Investigation of the nature of the changes in the tissues of the animal, which accompany the process of immunisation by the injection of bacteria or their products, and which form the basis of the new condition of acquired resistance, led to the discovery that the blood and serum of such immunised animals contain substances capable of neutralising the inoculated poison or destroying the inoculated organism. The discovery of the formation of substances antidotal to bacterial toxins is associated with the names of Salmon and Theobald Smith, Brieger and Kitasato, Roux and Yersin, Chantemesse and Charrin and others. Pfeiffer showed clearly that many organisms, such as the bacilli of cholera and typhoid, streptococci, etc., to which the animal body can acquire a high degree of immunity, form no significant amount of soluble toxins. Metschnikoff and his followers attributed the defence of the organism against such invaders to the phagocytic activity of the leucocytes; but here again the work of many observers, starting with Flügge and Nuttall, showed that the body fluids of the immune animal contain substances which destroy the vitality and even the structural integrity of the infecting organisms.

Blood and serum

It may be noted that the apparent gap between the phagocytic and humoral theories of immunity against bacteria, has been bridged to some extent of recent years by the description of "opsonins" (Wright), bodies which so alter the bacteria that they are defenceless against the attack of the leucocytes. Another great step was made when it was shown that the protective anti-bodies, whether antitoxic or anti-bacterial in action, could be transferred to an animal not actively immunised. This was shown by Richet and Hericourt to be possible with serum from an animal immunised against pyogenic cocci. A few years later came the classical work of Behring and Kitasato, proving the possibility of transferring immunity against the toxins of tetanus and diphtheria, by injecting into a normal

"Opsonins"

PROF. BEHRING

animal, serum from an animal rendered immune by a course of inoculation with such toxin. The introduction of these two antitoxic sera, obtained from highly immunised horses, into practical human therapeutics, in which Roux also played an important part, formed the beginning of serum therapy as distinguished from inoculation; and they still hold their place as the most unquestionably efficacious among the various sera now available for use, though Flexner's recent results with an anti-meningococcus serum, in epidemic cerebro-spinal meningitis (spotted fever), bid fair to challenge this supremacy.

Beginning of serum therapy

It will be seen that the rival methods of inoculating and immunising the patient himself on the one hand, and transferring serum from an animal immunised by inoculation on the other, aim at inducing two distinct types of immunity, called "active" and "passive" respectively by Ehrlich. These researches, starting with and brilliantly solving the problem of the exact evaluation of sera for practical use, led him to enunciate those conceptions of the mechanism of the immune reaction which have furnished the stimulus for and fixed the direction of an enormous proportion of recent work on the subject.

"Active" and "passive" immunity

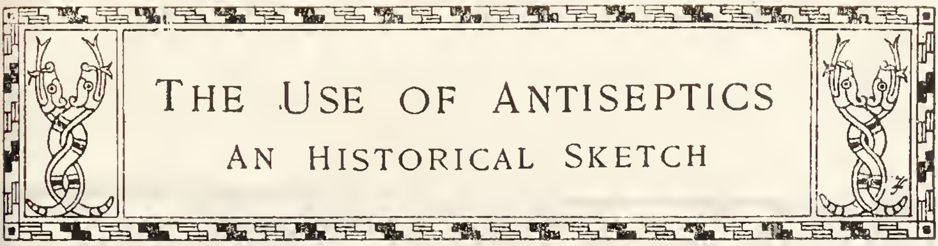
From this brief summary of the results, which man, with such patience and ingenuity, has achieved in recent years over these insidious enemies of his well-being, some idea of the value of inoculative treatment may be estimated. Serum treatment is but as yet in its infancy, and its possibilities in the future are great. The success that has followed its employment in modern times promises that it may eventually prove one of the most helpful branches of the healing art, especially in combating some of the most terrible diseases with which mankind is afflicted.

IXTLILTON

IXTLILTON WAS REGARDED BY THE ANTIENT MEXICANS AS THE DEITY OF HEALING. TO HIM THEY TURNED WHEN SICK OR AFFLICTED AND IMPLORED HIS AID TO HEAL THEM OF THEIR DISEASES

THE USE OF ANTISEPTICS

AN HISTORICAL SKETCH



THE ASTROLOGICAL SIGN OF THE SERPENT AS REPRESENTED BY THE ANTIENT MEXICANS

Derivation and meaning of the word "antiseptic"

THERE are probably few words more familiar to the hospital nurse than "antiseptic." To some, however, it is possible the term may simply suggest some chemical solution or dressing that is applied to a wound, while the principles which underlie the reasons for using it may not be quite clear. As the subject is one of considerable interest to every nurse, it is proposed briefly to trace the history of the use of antiseptics in surgery, from antient to modern times.

The term antiseptic is now generally applied to substances used to prevent or arrest putrefaction or analogous fermentative changes, and is derived from the Greek words *anti* = against and *septikos* = causing putrefaction.

Definition of asepsis and antisepsis

First recorded use of word antiseptic

When a wound is in a foul or putrefactive condition it is said to be *septic*, on the other hand, when it is in a healthy state it is termed *aseptic*. The principles on which antiseptic surgery is founded may be summed up in the following sentence: *asepsis* is the principle of preventing access of germs, while *antisepsis* is the principle of destroying germs. The first known use of the word antiseptic occurs in a work on the plague by Place in 1721, in which he states "this phenomenon shows the motion of the pestilential poison to be putrefactive, it makes the use of antisepticks a reasonable way to oppose it," but though the principles of antisepsis were not scientifically understood at that time, they have been practised, as we shall presently show, from a very early period.

The necessity of preventing putrefaction in dead matter appears to be instinctive among certain animals and insects, and many living things are known to protect

Dog Licking a Wound and an Angel Applying a Dressing to the Same

From a Woodcut of the XV century

themselves by various ingenious methods from destructive septic influences. An instance of this may be taken from the life of the bee. Should an intruder in the form of an insect or moth make its way into the hive, it is speedily killed and ejected, but if this is impracticable, owing to its position or size, the body is methodically and hermetically enclosed in a sepulchre of wax, so that, excluded from the air, and preserved by the formic acid secretion of the sting, putrefaction is prevented, and the bees in the hive are protected from septic influences. It has also been noted that when dealing with snails the bee is content to seal up with wax the orifice of the shell, so utilising the intruder's equipment as its own tomb. As we shall see later on, honey was recognised and employed as a preservative in antient times, and was used by the Greek physicians as a dressing for wounds.

The natural antiseptic of the bee

In connection with the poisonous products of putrefaction it is a curious fact, that such birds of prey as the vulture appear to be immune from their evil effects, and they can eat with impunity large quantities of diseased and putrified animal tissue. Other birds appear to possess a remarkable instinct for surgery, which is even accompanied by natural antiseptic treatment. Expert naturalists have observed that the woodcock and the partridge are able to dress their wounds with considerable skill. It was noticed in the case of several woodcock which were shot, that they were recovering from wounds which had been previously received, and in every case the injury was found to be neatly dressed with soft down plucked from the stems of feathers and skilfully arranged over the wound, evidently by means of the long beak of the bird. In other cases it was observed that ligatures had been applied to wounded or broken limbs.

The surgical instinct of birds

Everyone must have noticed how an animal will immediately lick its wounds or lacerations, and often, without other care, such wounds heal in a remarkably short time. By licking, the wound is cleansed, and it is quite probable that the salts in solution in the saliva act as nature's antiseptic, and, by frequent application of the tongue, assist the wound to heal.

Animal instincts in healing wounds

Man seems to have been more backward than the lower animal creation in recognising the danger that menaced him from the putrefaction of matter. The earliest method that was probably employed by him as a preservative was the simple and primitive process of drying, which, if completely carried out, prevents the ordinary putrefactive changes taking place. In hot, dry countries this method seems to have been extensively practised, and in this way the prehistoric inhabitants of Egypt originally preserved their dead.

Earliest method of preserving, employed by man

Smoking was also employed as a preservative in very early times, and has even survived to the present day as a method of curing fish, pork and other animal substances. This is now known to be due to the antiseptic action of the creosote in the smoke from wood. Refrigeration, by means of which animal matter kept at a low temperature resists putrefaction, now so largely employed in the importation of meat, is but an adaptation of Nature's processes, illustrated by the carcases of long extinct mammoths, which have been discovered in the ice cliffs of Siberia, with the flesh still upon them.

Smoking as a preservative

The preservation of animal matter by natural salts such as the chlorides and nitrates of sodium has no doubt been employed from the early ages. The preservation of fish in this manner was practised in antient times by the Egyptians, and also by the Scandinavians in the north of Europe.

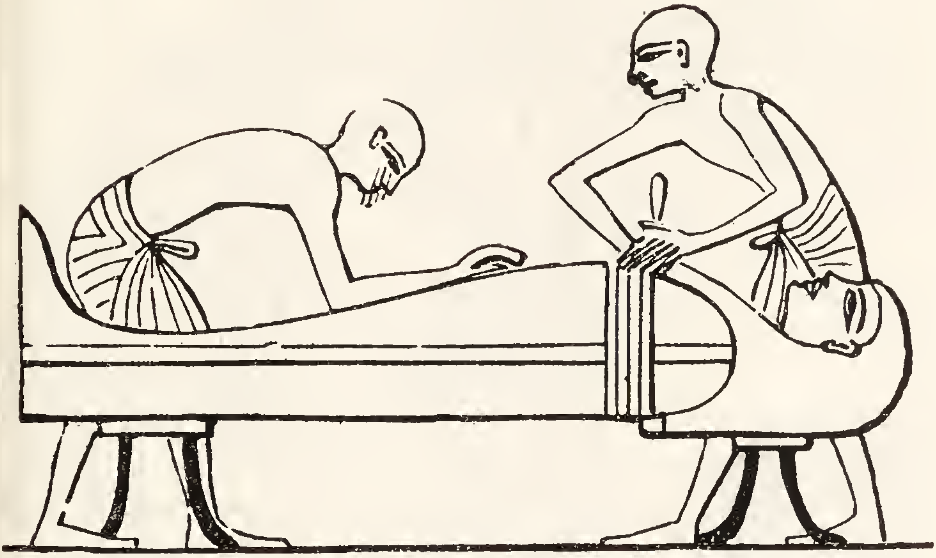
Salting as a preservative

The antiquity of embalming or preserving the human body from decomposition is very great. The earliest method, employed by the Egyptians in prehistoric times, is said to have been carried out by first slowly drying the body and then washing it with a strong solution of natron, the natural carbonate of sodium found in Egypt.

Earliest method of embalming

At a later period a more elaborate process of embalming was performed by means of the insertion of certain oils, gums

and resins into the cavity of the body after the moister portions had been removed. Finally the body was washed with oil of cedar and natron.



ANTIENT EGYPTIANS EMBALMING A BODY

Another method of embalming was carried out as follows:—The brain and intestines were first removed, after which the abdomen was washed clean with palm wine and then filled with myrrh, cassia and other aromatic gums and gum-resins. The body was then soaked for seventy days in a solution of natron, and was finally bandaged with gummed linen or cloth. In some processes a liquid distillate of pitch pine was used, also tar, bitumen and asphalt. It should be noted that practically all the substances employed by the early Egyptians in their processes of embalming possessed antiseptic properties to a greater or less extent.

Method of embalming used by the Egyptians

At a much later period, about the third or fourth century B.C., honey was employed for preserving the body after death. Thus the body of Alexander the Great is said to have been embalmed with honey, and by this means also the body of Agesipolis I, was preserved during its conveyance from Sparta for burial.

A Soldier of Antient Greece having wounded Foot Dressed

From a bronze ca, 250 B.C.

From a recent investigation carried out at the Government School of Medicine in Cairo, it is stated on scientific evidence, that the early Egyptians simply pickled the bodies of their dead in brine, and that the various aromatic balsams and resins employed were mainly accessories to the process. The real agent at work was the extraordinarily dry climate of the country.

Recent light on Egyptian methods of embalming

It has been calculated that in Egypt seven million bodies have been embalmed, yet the idea of applying the principle to living flesh never seems to have occurred to the antients.

The Guanches, the aboriginal inhabitants of the Canaries, employed a method of embalming similar to that of the Egyptians.

Coming to the Grecian era, it is stated that the patients suffering from wounds, who came to the temple of Aesculapius at Epidaurus, were healed by the sacred serpents who licked the affected part. Hippocrates, the father of medicine (460 B.C.), in his work on wounds, observes that the surgeon should aim at keeping the wound dry, that condition being a healthier one than when it is wet. He recommends that wounds should be permitted to bleed freely and should be carefully cleansed. He was against the use of fatty substances as dressings, and advocated astringents, such as wine, alum dissolved in vinegar, galls, and the green bark of the fig tree. Another dressing he prepared by placing sour grapes in a vase of red copper in the sun, and adding honey, myrrh, nitre and a small quantity of turpentine, thereby making an application possessing undoubted antiseptic properties.

Antiseptics used by Hippocrates

The antiquity of oil and wine as a dressing for wounds is evidenced by the parable of the Good Samaritan related in the New Testament. In pouring oil and wine on the wounds of the man who was waylaid by the robbers, the Samaritan was probably using the method of "first-aid" practised by his countrymen, which, unknown to them, was a mild form of antiseptic treatment. *(See page 21)*

The use of oil and wine as a dressing for wounds

Celsus, who lived about A.D. 50, gives us a glimpse of the methods for healing wounds employed by the Roman surgeons. Following the Grecian method, they first carefully cleansed the part by washing with wine, vinegar, or oil. In other cases, honey was applied, or wool dipped in vinegar. To arrest hæmorrhage, the part was cauterised by means of a red-hot instrument. The Romans also recognised the antiseptic properties of certain earths of a calcareous nature as an application to wounds.

How the Romans treated wounds

Galen, the famous Greek physician and anatomist, who flourished A.D. 200, employed, as dressings, alum dissolved in wine, lime water and astringent plants. Honey, verdigris, turpentine and oil were also recommended by him for application to wounds, and he insisted that those that were putrid should be washed with wine. For suppressing hæmorrhage, when cold water and astringents failed, he employed unripe galls and stronger wines.

Oribasius, another celebrated Greek surgeon of the fourth century, followed the doctrines of Hippocrates, and strongly advocated the use of wine or vinegar, diluted with water, as an application to wounds. In some cases, he states, he found that the leaves of the papyrus plant, which had previously been soaked in wine, were of great value in arresting hæmorrhage, thereby forming a mild antiseptic plaster.

Albucasis, an Arabian physician, who died about 1106, in a treatise he wrote on surgery, recommends that a pad of cotton wool soaked in rose oil alone, or mixed with an astringent wine, should be placed on a wound. "If the wound," he continues, "is found to be affected by the *action of the air*, an ointment should be applied until suppuration occurs." The fact that Albucasis, in the eleventh century, recognised the evil of exposing a wound to the air, is very remarkable, and he may be fairly regarded as the pioneer in what is known to-day as aseptic surgery.

The Arabian physician Albucasis, observes the effect of the air on a wound

Another substance used by the Arab surgeons as a dressing for wounds, and which continued to be employed

for centuries afterwards in other countries, was the astringent gum-resin called "Dragon's Blood." The origin of its use for arresting hæmorrhage was probably due to its colour as, according to the old "Doctrine of Signatures," substances of the same colour or shape as organs of the body, or its secretions, had a beneficial effect upon them.

Arab methods of dressing wounds

From what is known of surgical treatment in Anglo-Saxon times, astringent substances such as powdered galls or the crushed leaves of some herb possessing styptic properties, were generally applied to a wound to arrest hæmorrhage. The treatment for wounds, employed by the Anglo-Saxon leeches, may be judged from the following recipes taken from an Anglo-Saxon Leech book written about the seventh century:—

Anglo-Saxon wound dressings

1. "A wound salve; take seed of waybread, bray it small, shed it on the wound, soon it will be better."
2. "For cleansing of a wound; take clean honey, warm it at the fire, put it then into a clean vessel, add salt and shake it till it have the thickness of brewit, smear the wound therewith, when it turneth foul. If there be a bone breach in the head pound maythe and goutweed well in honey, then add butter; that is a good salve."
3. "Again a wound salve; the groundsel which waxeth in highways, that is good for a wound salve, and ribwort, and yarrow and gith ripe; pound all the worts, boil in butter, and squeeze through a cloth."

It is curious to note how, even in a country so far removed from Grecian influence as Anglia, we find honey being used as a dressing for wounds.

From Anglo-Saxon times to the twelfth century was the darkest period in the history of surgery and, if anything, the art retrograded rather than progressed. Towards the close of the thirteenth century, however, Theodoric, Bishop of Cervia near Ravenna, who was learned in surgery, gave voice to principles that eventually laid the foundation of aseptic surgery.

Principles of aseptic surgery recognised

Surgeon Attending to a Wound on a Patient's Leg

From a Woodcut of the XV century

For centuries previous it had been believed, and taught, that the best method of treating a wound was to promote suppuration, and that every method should be used to keep it open, but Theodoric, writing in 1275, says: "It is not necessary as Roger and Roland have written, and as many of their disciples teach, and as all modern surgeons profess, that pus should be generated in wounds. No error can be greater than this. Such a practice is indeed to hinder nature, to prolong the disease, and to prevent the conglutination and consolidation of the wound."

Unfortunately Theodoric's theory was not believed, and the advocates of suppuration triumphed; and for centuries afterwards poultices and fats of various description continued to be applied to wounds, and tents plastered with irritants to promote suppuration thrust into them, even when there was no foreign matter to be discharged.

Theodoric and Mondeville's method of treating a wound

The method of treating a wound practised by Theodoric and Henry of Mondeville, his pupil, was to wash it with wine only, scrupulously removing every foreign particle, and then bringing the edges together and so excluding any form of dressing.

The favourite dressing of William of Saliceto, a physician who lived in the thirteenth century, was a mixture of rose oil and the whites of eggs, which he applied to the wound by means of feathers. Lanfranc, the French surgeon, 1265, improved on William's method of treatment, and observes that "a wound that will not close up by itself must be stitched with a needle having grooves through which a thread can pass. The wound should then be covered with the astringent powder of dragon's blood, taking care that it does not reach the inside of the wound where it would prevent consolidation. Over this a linen cloth soaked in a mixture of rose oil and white of egg should be placed, and over this a bandage."

Wound dressings recommended by William of Saliceto and Lanfranc

The invention of fire-arms as weapons of war, about the middle of the thirteenth century, opened up a new field for surgeons in the treatment of gun-shot wounds. From con-

APPLICATION OF THE ACTUAL CAUTERY TO A WOUND

From a Woodcut of the XVI century

temporary writers we learn that at the close of the fourteenth century their methods of treatment were still very crude. They believed that gunpowder was a burning, irritating substance that poisoned the wound, and relied on the application of warm hemp-seed oil to counteract its harmful effects. Nicolaus, a German, who was barber-surgeon to Duke Sigismund of Austria, was the first to introduce hemp-seed oil as a dressing for wounds. Gersdorff, another German surgeon, advocated pouring the oil into the wound, and insisted that it should be used two or three times in succession by pouring it out and filling the wound again. After this had been done he substituted for the oil an infusion of the inner bark of the linden, and elder blossoms, and later on applied drawing plasters. A celebrated ointment which enjoyed a great reputation in the middle ages as a dressing for all kinds of wounds was called "Egyptian ointment" and was composed of honey, one pound, vinegar, half-a-pound, sulphate of copper and alum, of each half-an-ounce. This dressing had undoubted antiseptic properties, and no doubt to some extent justified its reputation.

Early methods of dressing gun-shot wounds

"Egyptian ointment"

Braunschwig, a German surgeon (1497), also regarded gunpowder as a poison, and recommended, in order to neutralise its evil effects, the pouring into the wound of warm oil of violets. He also mentions camphor and oil of turpentine as local dressings, and recommends keeping the wounds open by means of tents rubbed with pork. In 1563, Felix Würz, a Swiss surgeon, advocated a new treatment for wounds, and to stop hæmorrhage he used crocus martis (oxide of iron), alum, and the white hair of the rabbit. He strongly opposed the use of the actual cautery as aggravating the pain, and deprecated the use of salves and dirty oils, in place of which he strongly recommended honey as the best local application.

Method of dressing wounds advocated by Braunschwig and Würz

Little progress was made in surgical treatment until the end of the fifteenth century. The surgeon of that period still relied on the red-hot cautery to arrest the flow of blood, and then dressed the wound with an ointment composed probably of dried earth worms in

Surgical treatment in the XV century

PARACELSUS

From a Woodcut of the XVI century

powder, Armenian bole, camphor, and oil of roses. He might, indeed, have inserted a drainage tube of reed or animal membrane such as the windpipe of a rabbit.

The mortality from hæmorrhage on the battlefields and in operations at this period must have been terrible, for the boiling pitch or oil, the red-hot iron, the styptic pellets and other primitive methods of arresting blood were quite inadequate, and must at times even have accelerated death.

In a treatise on surgery, written by Duchene towards the close of the sixteenth century, there are some very original and remarkable statements with respect to the treatment of wounds. He says: "I think it worth mentioning that many use, not only for the first dressing, but throughout the entire treatment of the wounds, simply tepid spring water, to which some add a little oil and vinegar. They wash the wound with it and lay upon it wet lint or tow, and so successful is the result that people are astonished, and believe it is the result of a charm of magic words."

Duchene makes some remarkable observations

He advocated that a little oil and vinegar should be added to the water, "for," he states, "it is clear that vinegar resists corruption, for the reason that if something is put in it, it is conserved, and will not putrefy. Oil acts in the same way, and if poured on wine or other liquor it prevents it turning sour by preventing the air coming to it."

It must be readily acknowledged that these observations, which were made in 1576, practically outlined the principles which Lister brought into prominence three hundred years later.

John Vigo, the author of one of the most popular works on surgery in the sixteenth century, followed the antient custom of cauterising wounds with boiling oil.

Ambroise Paré, the father of French surgery, is said to have been the first to put a stop to the terrible treatment of arresting hæmorrhage with boiling oil. The story is told that once, after a certain battle, Paré found to his horror that no more boiling oil was available for the surgeons, and that he would be obliged to resort to some other method of treatment.

Ambroise Paré

"At last," he states, "I was forced instead thereof to apply a mixture of the yolkes of eggs, oil of roses and turpentine, a mixture which produced such excellent results that I resolved never more to burn thus cruelly poor men with gunshot wounds." The usual dressing consisted of oil of elders mixed with treacle. Paré mentions how once he visited, at Turin, a surgeon who had invented a famous balm for dressing gunshot wounds. He states: "He made me pay court to him for two years before I could possibly draw the recipe from him. In the end, thanks to my gifts and presents, he gave it to me, which was to boil an oil of lilies, young whelps, just born, and earth worms prepared with Venetian turpentine. Then I was joyful and my heart made glad that I had understood his remedy, which was like that which I had obtained by chance." Paré experimented with other dressings, and in his works he advises the following treatment for a suppurating thigh: "The thigh and the whole of the leg must be fomented with a decoction of sage and rosemary, thyme, lavender, flowers of camomile and melilot, red roses boiled in white wine with a drying powder made of oak ashes and a little vinegar and half a handful of salt." For a compound fracture he recommends white of egg, flour, soot from the chimney, and fresh butter melted, to be applied to the wound.

Paré revives the use of the ligature

But Ambroise Paré initiated a still greater advance in surgical treatment by using the ligature in place of the actual cautery or red-hot knife, in cases of amputation. He followed the French Army during many long and hard campaigns, and it was on the battlefield at the Siege of Damvilliers in 1552, that he first put his idea into practice. His teaching and practice concerning the ligature met with violent opposition, and it took a long time before it was universally recognised as the safest and most reliable treatment.

Paré did not invent the ligature, as is generally supposed, but merely re-discovered its use. Celsus speaks of it as an ordinary method in treating wounds, and Archigenes of Apamea tied vessels in amputating, after fixing a tight band at the root of the limb.

The Good Samaritan

From an engraving

See page 11

Ambroise Paré

Born 1517 Died 1590

See page 19

During the latter part of the sixteenth century, hot wine fomentations seem to have been a favourite method of treating wounds, although Delacroix, another famous French surgeon, still advocated and used boiling pitch, oil and turpentine.

Early in the seventeenth century, Paracelsus pointed out the abuse of the suture so much employed by surgeons of the day and declared that Nature healed wounds by a "curative balm" if left to herself. He observed the benefit to a wound when the air had been excluded, and recommended the use of a solution of lead acetate in surgical treatment.

Paracelsus points out the abuse of the suture.

But, although many of the substances used at this time were antiseptics of a mild nature, unfortunately they had not sufficient germicidal power to render them effective.

Gersdorff, an Alsatian surgeon of great experience, who lived at this period, was a disciple of Parè's and abandoned the use of the cautery and boiling oil. He employed a styptic of his own, which he kept secret, and after amputating, was accustomed to cover the stump of the limb with a bull's bladder and so protected it from the air.

Gersdorff uses a secret styptic

During the sixteenth and seventeenth centuries superstition and witchcraft played a prominent part in the treatment of wounds. Ointments composed of human fat and the fat of different animals were looked upon as potent healers. Kenelm Digby's method of treatment with his "Sympathetic Powder" or weapon salve, the virtues of which were so loudly extolled, had the merit at least of not interfering with Nature's own process of healing. Digby advocated that his salve should be applied to the weapon instead of the wound, the latter being simply cleansed and wrapped in clean bandages.

Surgical treatment in the XVI and XVII centuries

There was little actual advance at this period towards surgical antisepsis, but two very important discoveries were made which materially assisted the great discoveries that were to come. About 1690, Leeuwenhoek, a Dutch physician, who had been making observations on the larvæ of frogs and other small animals

Two important discoveries

was able to see, with his improved microscope, organisms which hitherto were unknown, and to him may be justly ascribed the discovery of what were afterwards called microbes. Redi, a poet of Tuscany, about the same period, by some simple experiments, also proved that the theory that maggots were spontaneously generated was wrong. He showed that, by protecting a piece of meat with fine wire gauze so that flies were prevented from depositing their eggs upon it, maggots do not appear. Crude though his experiment was, Huxley considered it the foundation of modern bacteriological technique, and the wire gauze was the forerunner of the antiseptic gauze of modern surgery.

Surgical treatment in the XVIII century

Coming to the eighteenth century, the method adopted by surgeons in the treatment of wounds underwent little variation. Wine, walnut leaves, aloes, myrrh, alum, borax and nitre were the chief dressings used for wounds, while the boiling pitch and tar were still generally employed by both naval and military surgeons down to the early part of the nineteenth century.

Place's theories on putrefaction

Some attempt at the drainage of wounds was made by Perceval Pott, Benjamin Bell and other famous surgeons of the period, and a glimmer of light on the causation of internal disease began to be manifested. In an article on the plague, written by Place in 1721, the following remarkable statement is made:—" As this phenomenon shows the motion of the pestilential poison to be putrefactive, it makes the use of antisepticks a reasonable way to oppose it, and whatever resists and is preservative against putrefaction admits not of the generation of insects. If this hypothesis is proceeded upon, our proper and promising materials to yield medicine and for physical preparations against it, such as cedar, Irish oak, cinnamon, spices and what was used by the antients in their embalments of dead bodies; *for the same virtues that preserve dead bodies from insects and putrefaction I know no reason why they should not preserve the same bodies living from the same thing.*"

But unfortunately Place did not put his theories into practice, although he appears to have clearly recognised the principles upon which antiseptic surgery is founded. Other pioneers in the eighteenth century who must not be forgotten were Pringle and Short, who experimented with the comparative antiseptic power of various chemicals on dead matter subject to putrefaction.

Pringle and Short's experiments

But although many investigators were so near the mark, they never seemed to grasp the importance of applying the principles they had discovered and putting them to practical use.

An amusing story is told of a veterinary surgeon in Yorkshire who practised over a century ago, and was famed throughout the countryside as a most successful operator. When asked as to his method of treatment he always evaded the question with great astuteness, and would never give away the secret of his success. At length when he grew to be a very old man, and became bowed down with age and weight of years, he was again implored by his son, to tell him before he died what he did in the secret half hour that he always gave himself before operating. Life was ebbing when the old man at length whispered with his passing breath into his son's ear, "I biles my tools."

A pioneer in sterilisation

Thus in ignorance, and unconscious of the cause, he had achieved his success by the application of the principle on which aseptic surgery has since been based.

The advent of the nineteenth century saw the dawn of a new era which was destined to revolutionise the surgical art.

Appert, a French confectioner, who discovered a method of preserving meat, fruit and vegetables by means of excluding the air and hermetically sealing, in the early part of the nineteenth century, was one of the first to contribute to the growing knowledge of the principles underlying antisepsis.

Appert's discovery

In 1835, Bassi undertook an investigation of the disease in silk-worms which was known as muscardine. He found, and

proved, that it was caused by a parasite, and discovered that the parasite could be killed by certain substances. He was a man of keen penetration, and foresaw that this discovery meant something more than the elucidation of the cause of the silk-worm disease. He stated his belief that smallpox, plague and other contagious diseases were produced by vegetable or animal parasites, and that gangrene was caused by such entities. In his own words, "observation and experiment demonstrate to us that all contagions disappear or cease to act in the individual whom they assail when agents or means are used capable of destroying the life of the animal or vegetable organism of the lowest classes, the producers, so to speak, of contagious diseases."

Bassi's researches

Bassi actually cured certain ulcerations by injections of corrosive sublimate, which is so largely used in antiseptic surgery to-day.

Ten years elapsed before the next step in advance was made by Semmelweiss, an Austrian physician, who discovered that puerperal fever, the rate of mortality from which was terribly high in the General Hospital at Vienna, was due to infection borne from the dissecting room on the hands of the students. He insisted that before proceeding to examine any patient the student should thoroughly cleanse his hands with chlorine or chlorinated lime water. The result of these precautions reduced the death rate from 12·24 per cent. to 1·27 per cent. But in spite of such extraordinary results and the vigorous manner in which Semmelweiss advocated his doctrines, the principles he laid down were neglected and bore no fruit.

The methods advocated by Semmelweiss

The next great advance came as a direct outgrowth of Pasteur's studies of the fermentation of alcoholic beverages. The result of his researches was far reaching and proved, not only that the fermentation of beer and wine was due to living organisms, but that many other fermentations, and, indeed, all putrefactions, were due to the same cause. It was but a step from the

Pasteur's researches on fermentation

Louis Pasteur

Born 1822 Died 1895

Lord Lister

Born 1827

fermentation of sugar to the principle that suppuration is a fermentation of the flesh, and that this might be prevented by destroying the germs that caused it or by preventing their entrance.

Although Pasteur himself saw the bearing that these discoveries were likely to have on the surgical art, it was left to Lister to carry out and apply them to their great life-saving conclusions.

Joseph Lister was born on April 5, 1827, at Upton in Essex. His father was a merchant in the City of London, and he received his early education at a school kept by members of the Society of Friends, at Tottenham. He subsequently proceeded to University College, and took his B.A. degree at the early age of twenty. He then spent five years in the study of medicine at the medical faculty of University College and at University College Hospital, graduating in medicine in 1852. After serving the usual offices in hospital he determined to visit Edinburgh to obtain experience under Syme, to whom he became assistant.

Lister's early life

In 1860, he was appointed Professor of Surgery to Glasgow University, but before leaving for that city he had already commenced his bacteriological work in connection with antiseptics. In 1865, he communicated to the *Lancet* a series of papers, in which he laid down as the basis of his methods the principles established by the philosophical researches of Pasteur.

Appointed Professor of Surgery to Glasgow University

At the period of Lister's appointment to Glasgow, tetanus, erysipelas, septicæmia, pyæmia and hospital gangrene were scarcely ever absent from the wards of our hospitals. There was no certain knowledge of the causation of these wound-begotten diseases, and no sure means of avoiding them.

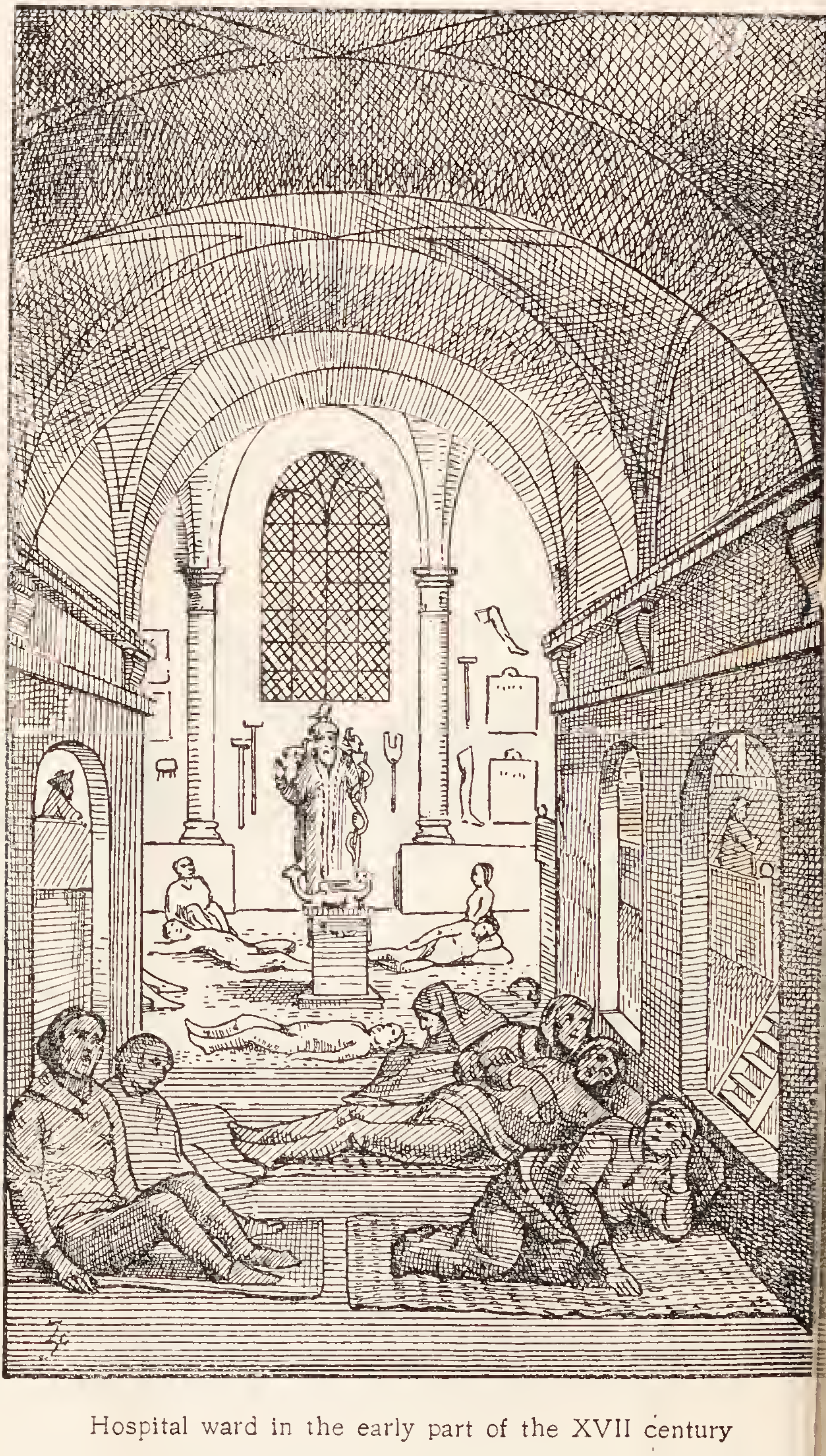
Many a surgeon's heart was well-nigh broken by these terrible visitants, after he had done everything that lay in his power to bring about his patient's recovery.

THE EARLIEST KNOWN EGYPTIAN DEITY
OF MEDICINE AND HEALING

I-EM-HETEP was the good physician of gods and men. There is little doubt that he was a real personage, renowned for his skill in healing, who lived in the reign of Tser of the II Dynasty, and was afterwards deified.

In the Diary for 1902, a representation was given of the figure of I-em-hetep from a bronze statuette in the Gizeh Museum, Cairo. The above is reproduced from an original bronze statuette, now in the possession of Mr. Henry S Wellcome, which is of great beauty and probably unique.

A CONSULTATION OF PHYSICIANS



Hospital ward in the early part of the XVII century

HOSPITALS AND THEIR ORIGIN

The origin of the hospital can hardly be ascribed to any particular race or country, as the idea of providing a place of succour for the sick and suffering seems to have been implanted in the human mind from time immemorial.

Hospitals, indeed, are the outcome of that innate pity and compassion which distinguishes all humane souls of whatever race or clime. In very remote times there is evidence that the Egyptians and the Babylonians brought their sick and laid them in the market place, so that those who passed by who had had an experience of like diseases might give them advice to alleviate their sufferings.

At a later period, it is stated, the Egyptians carried those suffering from disease to the temples to be healed. It is, therefore, probable that at Säis and Heliopolis, which were the chief seats of medical learning, patients received treatment in the great halls attached to those buildings.

The early Egyptian temples were also centres of medical knowledge, where the sick went to consult the deity who answered them in their dreams. They probably also served as hospitals or places of reception for those who were suffering from disease.

As early as 1100 B.C., there was a college of physicians in Egypt. Its graduates were paid by the State, and their practice regulated by law. According to Pliny, they were required to treat the poor gratuitously, which they probably did in official houses to which the patients went at certain times to submit themselves for treatment.

Among the Hebrews from very early times medicine has been held in high esteem. At the pool of Bethesda, a number of sheds were erected on the banks for the lodgment of the sick who came to drink the waters, which were thought to possess great curative virtues.

Physic and Surgery appear to have been treated as distinct arts and in the book of Ezekiel we have mention of the latter in the following words:—" I have broken the arm of Pharaoh, King of Egypt. It shall not be bound up to be healed, to put a roller to bind it."

The contagious nature of leprosy was believed in, and the sufferers from this disease were isolated and treated in the leper houses.

There is record of the existence of hospitals in India as early as 300 years B.C., for among the edicts of King Asoka, which are graven in the rocks of Gujerat, there is one commanding the establishment of hospitals throughout his dominions. There is also a tradition concerning this ruler, that, being grieved at seeing how often people died from disease which might be cured, he established dispensaries at the four gates of his royal city of Patna. Six hundred years later, when Fa-Hian, a Chinese traveller visited India, he found there hospitals, which in many respects resembled our modern institutions. In the record of his travels he states: "The nobles and landowners of this country have founded hospitals in the city, to which the poor of all countries, the destitute, the crippled, the diseased, may repair for shelter. They receive every kind of requisite help gratuitously. Physicians inspect their diseases, and, according to their cases, order them food and drink, decoctions or medicines, everything, in fact, that may contribute to their ease. When cured, they depart at their own convenience."

The Greek Abatons, that were attached to the temples in which the principles and practice of Æsculapius were venerated, probably did duty also as hospitals, while the attendants acted as nurses. To these temples patients came from far and wide to place themselves under the care of the priest physicians, who were supposed to be descendants of the deity, and known as Æsclepiades.

Long corridors did duty as wards, and a highly-prized sacred well was employed as a part of the treatment. At specified times, when patients collected at the temples, their courts and corridors would present the appearance of the outpatient waiting-room of a large hospital. The ritual embraced sleeping within the temple precincts, and the essential part of the cure was to dream a dream inspired by the god. A typical account is recorded in an inscription at Epidaurus as follows,—

"M. Julius Apellas, who was suffering from many complaints and from indigestion, was sent for by the god, but on the journey when I was at Arjenia, he bade me not be so

ıervous about myself, and when I was come to the precincts, ıe bade me go about for two days with my head covered. I vas to eat bread and cheese, a salad of celery with lettuce ; I vas to attend to myself in the bath, and drink lemonade, rub nyself against the wall of the bath, take exercise in the oggia, practice on the trapeze, rub myself with sand, and go barefoot, pour wine into the hot water of the bath before got in, bathe myself alone and give the bath attendant an Attic drachma, make offerings to Æsculapius and Epione and he Eleusinian goddess in common, and drink honey mixed vith milk. And one day, when I was drinking milk alone, he god said to me, 'put honey in your milk, that you may oe easier of digestion.' When I prayed the god to heal me nore quickly, I felt as if I was rubbed all over my body vith salt and mustard. Going from the shrine to the baths, saw a youth with a smoking censer, and the priest said, Your cure is accomplished, and now you must pay your fee.' stayed on still longer, and he bade me use anise and oil for ny headache, but just then I had no headache : however, it ıappened that through working too hard, I got a rush of olood to the head. I used the oil, and my headache went. He ordered me to gargle with cold water for a swelling in he glands. Cured and grateful, I have departed."

In the year 170 A.D., Antoninus had two buildings erected ıt Epidaurus, one for the dying and another for women, which may perhaps be regarded as among the first regular ıospitals of which there is authentic record.

The Romans, who adopted many of their institutions from he Greeks, had a temple dedicated to Æsculapius, situated on an island in the Tiber, which they also used as a hospital for the sick. At a later period the hospital system became common in many of the large cities of the Empire. In the year 380 A.D., Fabiola, a Roman matron devoted to good works, established a house in the country for the sick and nfirm, where they could be furnished in a regular manner with nourishment and those medicines of which they might stand in need. "The fame of this institution," says St. Jerome, "spread throughout the Roman Empire, from the Egyptians and Parthians to the cities of Britain."

Another hospital was built by St. Basil outside the walls of Cæsarea in Cappadocia. This edifice was so large that t is said by St. Gregory Nazianzen to have looked like

Hospital ward in the latter part of the XVII century

a second city, the abode of charity, the treasury into which ne rich poured of their wealth, and the poor of their poverty. Here disease was investigated and sympathy proved." At nis period, Alexandria, which was a famous seat of medical earning, must have possessed a number of hospitals, for a aw of the Emperor Honorius mentions no less than six undred nurses, who were placed at the disposal of the ishop, for the purpose of nursing the sick. These nurses ore the name of *parabolani*, which originally signified urses of infectious diseases.

The Romans in the time of Hadrian were probably the rst to establish military hospitals. They were attached to he legionary camp during war, and replaced the tent where he sick and wounded soldiers were formerly treated.

Passing to the Western Hemisphere, the antient Aztecs, r Mexicans, are said to have had hospitals in their principal ities for the cure of the sick, and for the permanent refuge f disabled soldiers.

Bancroft affirms that these establishments were also amply ndowed, and attended by experienced physicians, surgeons nd nurses.

The origin of Christian benefaction dates back to the very oundation of Christianity. Christ himself healed the sick nd maimed, and His example was imitated by His followers, vho vied with each other in ministering to the sick and ieedy.

This work of the Christians excited the emulation of their nemies, for it is stated when the Emperor Julian heard f it he exclaimed, "These impious Galileans give themelves to this kind of humanity; let us establish abundance f hospitals in every city, that our kindness may be enjoyed y strangers, not only of our own people but those who are n need."

At first there were no separate institutions for the exercise f Christian charity, but it was carried on in private houses imilar to the surgical homes of the present time. After a vhile, however, the monasteries took up the cause, and separate houses or hospices for the sick, called infirmaries, were ttached to the priories and churches.

There were several varieties of these infirmaries, some eing devoted to cloister patients, and others to sick

Operating room in a hospital of the XVII century

strangers. In the hospitals, which in Scotland, in 845 A.D., were placed under ecclesiastical protection, separate departments were formed according to the malady to be treated, and the patients were classed as bed-ridden, convalescents or incurables.

It is stated that in 680 A.D. it was even customary to bring the moribund into a separate chamber to die.

Among the earliest of these hospices were those of Mont Cenis, founded in 825, and the Great St. Bernard, founded in 980, both of which are in existence to-day.

A hospital of the XIV century

Besides the monastic infirmaries, during the twelfth century a number of institutions were established whose sole object was the reception and treatment of the sick. The golden age of these establishments began after the crusades, in consequence of which, leprosy, in particular, was distributed throughout the west. During the middle ages, leper hospitals became so numerous in Europe that it is computed there were no less than 19,000 of these institutions in existence in the thirteenth century.

Hospital ward in the early part of the XVIII century

The Knights Hospitallers, Knights of St. John of Jerusalem, of Rhodes, and of Malta, were founded by men of noble families who voluntarily gave up their lives, and took an oath to succour the needy and minister to the sick. Their first hospital was built in the ninth century at Siena. The order was established in Jerusalem after the taking of that city by the Crusaders in 1099. Their first grand master, Gerard Tour, provided hospitality for pilgrims, and tended them when sick. In 1121, they took up arms against the Saracens, and thus became a military as well as a religious organisation.

On Saladin re-taking Jerusalem, they retired first to Acre, and afterwards to Rhodes, in 1380. Driven from this island, after a memorable defence, they established themselves in Malta, which had been given to the community by Charles V. They remained there for three centuries until Malta fell into the hands of Napoleon, who removed the order to France.

The statutes of the hospital of St. John provided that four salaried physicians should always be employed, and that they should be skilled in uroscopy and other arts. The patients were to receive fresh pork, mutton or poultry thrice a week. Surgeons were also appointed to attend in certain cases.

A kindred order, the Brother Hospitallers, was founded by John de Dios, a Portuguese, about 1530. He commenced in a very humble way by converting his home, which was little more than a shed, into a primitive hospital. From this small beginning sprang many early hospitals and asylums for the destitute and sick, such as the "Brotherhood of the Caritio" in Spain, the "Misericordia" in Italy, and the "Maisons de Charité" in France. All these institutions were under the direction of the church, and their helpers and assistants were the priests, especially members of the religious orders.

One of the earliest independent hospitals was the Hotel-Dieu in Paris, which was founded by St. Landry, Bishop of Paris, at his own expense in the year 600 A.D. It originally combined the functions of an inn, asylum, infirmary, and a charitable organisation for the poor and needy.

The first hospitals in England were probably those for lepers. According to Sir James Simpson, there was one founded in Nottingham as early as the year 625, while certain others are said to have been in existence in Ireland in 869. Archbishop Lanfranc built a hospital in Canterbury in 1089,

and others were founded in Chatham and Northampton in the time of William Rufus. These institutions were mainly supported by small endowments, and had many benefactors.

Matilda, the Queen of Henry Beauclerc, endowed a hospital in London with the sum of three pounds, which was intended for the support of forty patients and three officers. The only other source of revenue at this time was the "Sound Dish," which convalescent patients took round for voluntary contributions to the fairs and markets.

In 1233, Henry III founded "an infirmarie for ye sicke" in Oxford, called St. John Baptist's Hospital, which stood on the site of the present Magdalen College. From its statutes, which are still in existence, we learn that "Sisters" formed part of the community, probably for tending the sick poor who were lodged in the infirmary. At this period, many hospitals seem to have been founded, as there are records of grants of land being made in Middlesex and Holbourne. In the year 1123, St. Bartholomew's Hospital was founded by Rahere, who was a minstrel to Henry I. It was refounded in 1547, and, escaping the Great Fire in 1666, was rebuilt in 1692.

The management and control of the hospitals remained in the hands of the monks until the time of the Reformation, when the estates and revenues were taken out of their hands, which change was by no means to the advantage of the patients. During the seventeenth and early part of the eighteenth centuries, hospital administration probably reached its lowest ebb. The buildings were allowed to fall into a wretched condition, so that "hospital fever" was never absent from the wards. In the Hotel-Dieu in Paris, several patients lay in a single bed, and the mortality amounted to 20 per cent. Almost all who underwent operations (particularly amputations) died. Patients suffering from infectious diseases were placed in the same bed with those who were not. The buildings often swarmed with vermin, and the air was so pestiferous in the sick wards, that in the morning nurses and attendants could only venture in by holding before their mouths a sponge saturated with vinegar. In the lower halls, which lacked light and air, there were no beds. On the tiled floor lay heaps of straw, and upon these pallets the sick were placed.

Dispensaries had their origin in 1687, when the Royal College of Physicians of London passed a resolution, enjoin-

ıg its licentiates, members and fellows, to give their advice ratis to all the neighbouring sick poor, when desired, in the ity of London or seven miles round.

In 1688, with a view to rendering this more effectual, it ·as resolved that the laboratory of the college should be tted up for preparing medicines for the poor, and also the ɔom adjoining for a repository.

This gave offence to the Apothecaries, and was the cause f a bitter dispute between the two bodies, which lasted for ears.

Towards the latter part of the 18th century, an improve-ıent was wrought both in hospital administration and con-ruction. In 1780, it was first suggested by Stoll and auken, two Austrian physicians, that hospitals should be uilt on an eminence, and that patients suffering from in-ectious diseases should be isolated, and placed in a separate uilding. An impetus was given to charitable organization, ıd what may be termed the "golden age" of hospital ɔnstruction began.

About this period eleven hospitals were built in London, iz., Guy's, St. George's, the London, Westminster, and the Iiddlesex from 1719 to 1747, and 27 were erected in the rovinces from 1710 to 1797. The Edinburgh Hospital was uilt in 1736, and in Dublin, Jervis Street Hospital in 1726, teven's Hospital in 1733, Mercer's in 1734, and the Meath Iospital in 1756.

These institutions became naturally the schools of England's reat practitioners, and the eminent physicians and surgeons ɔnnected with them attracted numerous pupils from all arts of Europe. But even at this period little was known sanitation and hygiene, and owing to defective ventilation, adly-cooked food, and ignorant nursing, down to the middle the 19th century, hospital administration was in a parlous ate.

It was not until the introduction of clinical instruction at a radical improvement took place. Since then, owing the rapid and marvellous advances made in science, the reat discoveries of Lister and Pasteur, together with the roper education of nurses, a revolution has been created roughout the hospitals of all civilised countries, for which ımanity should be devoutly thankful.

An Early Greek Physician and his Medical Cabinet
circa 300 B.C.

The manuscript works of the fathers of Greek medicine were in the form of scrolls. The surgical instruments are interesting as showing how little some of the forms have changed.

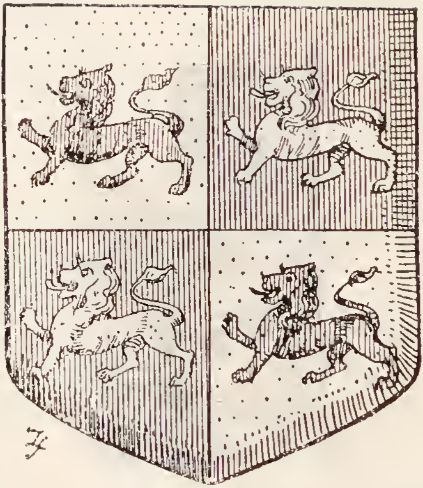
It appears to have been a practice with early Greek physicians to see their patients at elaborately equipped consulting rooms, which were situated at a distance from their dwellings.

The bulky nature of the medicines used by the antient Greeks forms a strong contrast to the compactness of the 'Tabloid' brand products of the present day.

The Standard of the Cross of King Cadwalladr Vendigaid, the last British King, supported by the Red Dragon of Wales

"Brodyr, gnawd ynddi prydydd;
Heb ganu ni bu ni bydd."

"This is a hospitable country, in which a poet is a matter of course. It has never been, and will never be, without song."—*Barrow.*



The Arms of Wales.

Hen

eddegyaeth Kymrie

(Antient Cymric Medicine)

and

Lecture Memoranda

BRITISH MEDICAL
ASSOCIATION MEETING
SWANSEA, 1903

urroughs Wellcome and Co.,

London, Sydney and Cape Town

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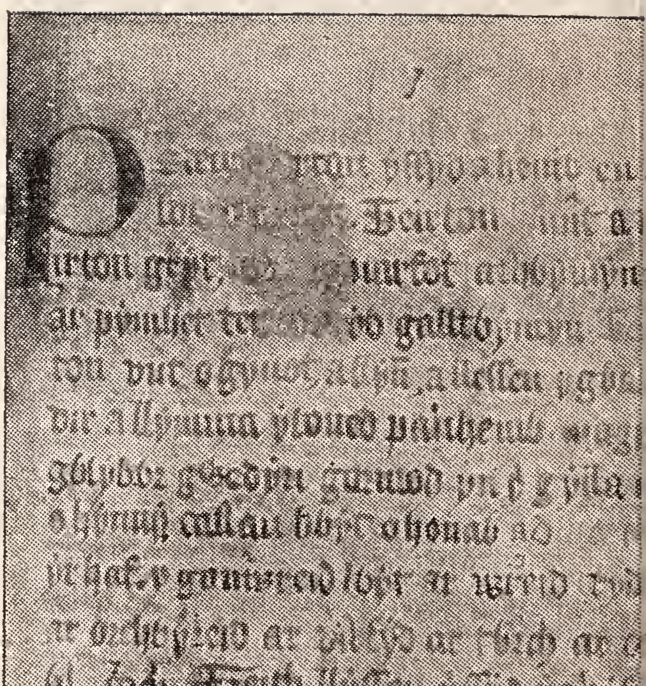
	SEPT.					OCT.					NOV.					DEC.			
S	.	6	13	20	27	.	4	11	18	25	1	8	15	22	29	.	6	13	20
M	.	7	14	21	28	.	5	12	19	26	2	9	16	23	30	.	7	14	21
Tu	1	8	15	22	29	.	6	13	20	27	3	10	17	24	..	1	8	15	22
W	2	9	16	23	30	.	7	14	21	28	4	11	18	25	.	2	9	16	23
Th	3	10	17	24	..	1	8	15	22	29	5	12	19	26	..	3	10	17	24
F	4	11	18	25	..	2	9	16	23	30	6	13	20	27	..	4	11	18	25
S	5	12	19	26	..	3	10	17	24	31	7	14	21	28	..	5	12	19	26

CALENDAR FOR 1904.

	JAN.						FEB.					MARCH					APRIL			
S	.	3	10	17	24	31	.	7	14	21	28	.	6	13	20	27	.	3	10	1
M	.	4	11	18	25	..	1	8	15	22	29	.	7	14	21	28	.	4	11	1
Tu	.	5	12	19	26	..	2	9	16	23	..	1	8	15	22	29	.	5	12	1
W	.	6	13	20	27	..	3	10	17	24	..	2	9	16	23	30	.	6	13	2
Th	.	7	14	21	28	..	4	11	18	25	..	3	10	17	24	31	.	7	14	2
F	1	8	15	22	29	..	5	12	19	26	..	4	11	18	25	..	1	8	15	2
S	2	9	16	23	30	..	6	13	20	27	..	5	12	19	26	..	2	9	16	2

	MAY					JUNE					JULY						AUG.			
S	1	8	15	22	29	.	5	12	19	26	.	3	10	17	24	31	.	7	14	2
M	2	9	16	23	30	.	6	13	20	27	.	4	11	18	25	..	1	8	15	2
Tu	3	10	17	24	31	.	7	14	21	28	.	5	12	19	26	..	2	9	16	2
W	4	11	18	25	..	1	8	15	22	29	.	6	13	20	27	..	3	10	17	2
Th	5	12	19	26	..	2	9	16	23	30	.	7	14	21	28	..	4	11	18	2
F	6	13	20	27	..	3	10	17	24	..	1	8	15	22	29	..	5	12	19	2
S	7	14	21	28	..	4	11	18	25	..	2	9	16	23	30	..	6	13	20	2

	SEPT.					OCT.						NOV.					DEC.			
S	.	4	11	18	25	.	2	9	16	23	30	.	6	13	20	27	.	4	11	1
M	.	5	12	19	26	.	3	10	17	24	31	.	7	14	21	28	.	5	12	1
Tu	.	6	13	20	27	.	4	11	18	25	..	1	8	15	22	29	.	6	13	2
W	.	7	14	21	28	.	5	12	19	26	..	2	9	16	23	30	.	7	14	2
Th	1	8	15	22	29	.	6	13	20	27	..	3	10	17	24	..	1	8	15	2
F	2	9	16	23	30	.	7	14	21	28	..	4	11	18	25	..	2	9	16	2
S	3	10	17	24	..	1	8	15	22	29	..	5	12	19	26	..	3	10	17	2



Fac simile page from the Meddygon Mydd[illegible] a manuscript medical work compiled by [illegible] physicians of Myddfai about the 13th century.

Antient Cymric Medicine

Although the early history of medicine in Wales is pregnant with interest, apparently little research has hitherto been devoted to it, and the references are scanty. Such information as has been gathered is fascinating in the extreme, and has amply rewarded investigation.

Medicine is said to have been included among "the nine rural arts known and practised by the ancient Cymry, before they became possessed of cities and a sovereignty," that is, before the time of Prydain ab Aedd Mawr, about 1,000 years B.C.

In that early period, the priests and teachers were the Gwyddoniaid, or men of knowledge, who were looked upon as being the chief sources of wisdom in the land. As among other early peoples, the Cymric priests of the Gwyddoniaid combined the office of healers of the body with that of teachers of religion.

It is to these men that the inception of the antient art of healing in Wales is attributed. The three sciences which they chiefly studied were astronomy, theology, and medical botany. The remedies they used in the treatment of the sick were mainly confined to herbs.

Map of Wallia (Wales), etc., A.D. 1250.

During the reign of Prydain, the Gwyddoniaid became divided into three orders, which consisted of the Druids, the Bards, and the Ovates, each of which had its peculiar duties as well as privileges.

The Druids were especially proficient in mystic and religious rites, and medicine; the Bards in oratory, poetry, and music; and the Ovates in natural sciences.

"... save when meditation
Gives place to holy rites; then, in the grove,
Each order has its rank and station."

As early as the year 430 B.C. (before the time of Hippocrates), there is evidence from the laws of Dyvnwal Moelmud, which were written about that period, that the art of medicine was protected and encouraged by the State. Therein medicine, commerce and navigation are called the three civil arts, each of which had a peculiar corporate privilege. This privilege is stated to have been "by the grant and creation of the lord of the territory, authenticated by the judicature, and distinct from the general privileges of a country and kindred."

It is probable that the Druids and Ovates became possessed of some knowledge of Grecian medicine through the Phœnicians, or the Etruscans, who traded with Britain, for in later times the name of Hippocrates is mentioned, and his works were much esteemed by the physicians of Myddfai.

The antiquity of the Druidic study of medicine is recorded by several of the early historians, and Strabo mentions that the Druids were acquainted with physiology.

The system of medical treatment, apart from their superstitious rites, was distinctly

ational. They first devised the means most kely to operate, and then called in the id of their religion, which was influenced y the peculiar superstitions of the time.

For internal diseases and lingering comlaints they appear to have chiefly conined the cold bath, exercise and change f place, with the administration of herbs nd simples. Important assistance was endered by drinking from certain wells, ne waters of which had special mineral roperties. They devised general prescripons for the preservation of health, in the orm of short maxims or aphorisms, comnending cheerfulness, temperance, exercise nd early rising.

The Druids devoted considerable time o the study of the medicinal properties of lants, and they believed some herbs to be ndowed with magical virtues. Prominent mongst these was vervain, used to anoint ne person, to prevent fevers, to procure riendships, and to obtain all the heart esired.

To preserve its mysterious properties, it vas necessary to gather the plant with certain eremonies at the rise of the dog-star, at a me when both the sun and moon were eneath the horizon. Before digging up ervain, the earth had to be propitiated by libation of honey, and the left hand only vas to be used. When uprooted, the plant vas to be waved aloft, and the leaves, talks, and roots dried separately in the hade. Vervain formed one of the ingreients in the mystical cauldron of Ceridwen.

With respect to the mistletoe, Pliny states hat "the Druids held nothing so sacred,

ARCH-DRUID.

Arch-Druid wearing the breast-plate of justic
and holding the golden sickle.

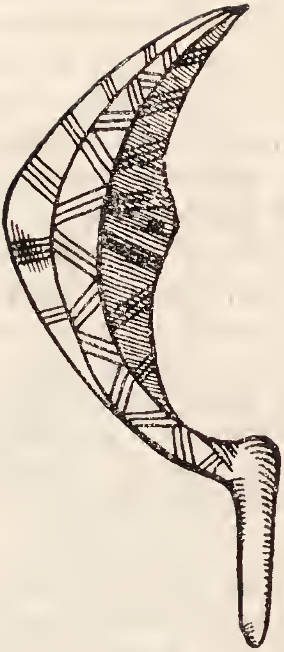
ovided the tree on which it grew was an k." They deified the mistletoe, and were t allowed to approach it, save in the most vout and reverential manner.

"They make choice of oak groves in eference to all others," he continues, nd perform no rites without oak leaves. ney think whatever grows on these trees sent from heaven, and is a sign that the ity has made a choice of that tree."

"As the mistletoe is seldom to be met th, when found it is fetched with great remony on the sixth day of the moon, hich with them begins the months and ars, and the period of thirty years, which ey term an age, for at that season the oon has sufficient influence, and is about lf full.

"They call this plant in their own lan- age 'All-heal,' and after preparing for e sacrifice and feast under the tree, they ing up two white bulls whose horns have en been bound for the first time. The rch-Druid, habited in white, mounts the ee, and with a gold sickle cuts the istletoe, which is received in a white cloth. he victims are then sacrificed, and prayers e offered to the deity, to render his gift vourable to those to whom they distribute . They suppose that it renders fruitful very animal that drinks a decoction of , and that it is a remedy against all sorts poisons."

Besides the many other medicinal virtues tributed by the Druids to the mistletoe, hich is still known by the old Druidical ame of "All-heal" in Wales, it was pecially valued as a preventive of



THE SACRED GOLDEN SICKLE.

"Perched on the tree that bears the golden bough,
Through the green leaves the glittering shadows gl
As on the sacred oak the wintry mistletoe;
He seized the shining bough with griping hold,
And rent away with ease the lingering gold"

Æneid.

The Druids ascribed mysterious powers to mistletoe, when it was found growing on an oak. the close of the year a solemn procession was form consisting of all three druidical orders. The w passed from mouth to mouth: "The New Year is hand, gather the mistletoe" A priest ascended tree, and with a golden sickle cut the mistle which was received on a white linen cloth spr upon the ground

terility, and was so regarded as an important factor in increasing and perpetuating the race.

The *Lycopodium Selago*, or hedge hyssop, was another plant highly esteemed by the Druids, and was employed by them in the treatment of affections of the eyes. Like the mistletoe, it was gathered with the greatest care. Nothing made of iron was allowed to touch it, nor was the bare hand thought worthy of that honour, but a peculiar vesture or *sagus* was applied by means of the right hand.

It was necessary that the vesture should be holy, and that it should have been taken from some sacred person privately, and with the left hand only. The gatherer must be a Druid clothed in white, his feet bare, having been washed in pure water. He had first to offer a sacrifice of bread and wine before proceeding to gather the plant, which was finally carried from the place where it grew, in a clean new napkin.

In the "Kadir Taliesin" the Selago is called "The Gift of God," Davydd (the subduer); and in modern Welsh it is termed "Grâs Duw," or "The Grace of God."

This plant was also regarded as a charm which would protect the owner against all misfortune.

The *Samolus*, or marsh wort, was supposed by the Druids to possess supernatural powers, and to be able to ward off, and to cure, certain diseases. The Cymric name for this plant was "Gwlydd."

There can be no doubt that the Druids carefully studied the properties of plants, and were skilful in the treatment of some

HOWEL DHA

AUTHOR OF "HEN LYFR Y TY GWYN."

The "Book of the White House" was the first codification of Cymric law

"Howel the Good, of Dyfed, constituted and gave lawes to be kept through his dominions, which were used in Wales till such time as the inhabitants received the lawes of England in the time of Edward I, and in somme places long after. These lawes are to be seen at this daie both in Latin and Welsh." Thus wrote Caradog of Llancarvin, but the original parchments were lost before 1300, although some fairly well authenticated extracts are still in existence. The "White House" is supposed to have been situated near what is now Whitland, in Carmarthenshire.

diseases, but how far their medical knowledge extended there is little evidence to show. Borlase asserts that they had a knowledge of anatomy, and demonstrated on the bodies of living men; but no evidence in proof of this statement has been produced.

Leaving the druidical period, the next historic reference to early Cymric medicine is made by Taliesin, who was "Chief of the Bards" in the 6th century.

This eminent chieftain was learned in medicine and physiology. He wrote of the body:—"There are three intractable substantial organs—the liver, the kidney and the heart. There are three intractable membranes—the dura mater, the peritoneum, and the urinary bladder. There are three tedious complaints—disease of the knee joints, disease of the substance of a rib, and phthisis, for when purulent matter has formed in one of these, it is not known when it will get well."

Between the sixth and the tenth centuries, little is known of the condition of medicine in Wales, for the country was torn by feuds and wars until the time of Howel Dha, named Howel the Good, who lived about 930 A.D. This monarch prescribed a code of laws, in which some very interesting references are made to the practitioner of medicine of that period.

One of the laws deals with the office and privileges of a mediciner or physician to the Royal Court, with an account of his duties and fees.

The court physician or mediciner was granted free land and a horse, and was also entitled to receive his linen clothing

from the Queen, and his woollen clothing from the King.

His seat in the hall within the palace, was at the base of a pillar near to the King, and his lodging was with the chief of the household.

His duties consisted in administering medicine gratuitously to all within the palace, and to the chief of the household.

He was to receive nothing from them "except their bloody clothes, unless it be for one of the three dangerous wounds, which are a stroke on the head unto the brain, a stroke on the body unto the bowels, and the breaking of one of the four limbs." For every one of these three dangerous wounds, the mediciner was to have nine score pence and his food, or one pound without his food, and also the patient's bloody clothes.

The mediciner was entitled to receive the following fees in certain circumstances.

"For applying a tent—24 pence.

"For an application of red ointment—12 pence.

"For an application of herbs to a swelling—4 legal pence.

"For letting blood—4 pence."

The mediciner was to take an indemnification from the kindred of a wounded person in case he died "from the remedy he shall use, and if he do not take it, let him answer for the deed."

He was to accompany the armies.

He was never to leave the palace but with the King's permission.

STONEHENGE RESTORED.

He was free to travel the road and out of the road along with the messenger of the sick.

It was lawful for anyone to take another's horse to procure a medical man for a person in danger, without being required to make amends.

The next authentic account of Cymric medicine dates from the early part of the thirteenth century, when flourished Rhys Gryg, a son of Rhys ab Gruffydd, who was a prince of South Wales. He was a great soldier, and took a prominent part in the feuds of the time. According to antient custom, he had his domestic physician, named Rhiwallon, who was assisted by his three sons, Cadwgan, Gruffydd, and Einion, and lived at a place called Myddfai in the county of Carmarthenshire. Under his patronage these physicians made a collection of medicinal recipes applicable to various diseases of the body "as a record of their skill lest no one should be found with the requisite knowledge as they were." Many of these prescriptions had been used in Wales from time immemorial, and some may be actually traced back to the time of Howel the Good, if not indeed to the sixth century.

The physicians of Myddfai, however, collected them, and put them in writing for the first time, and thus the valuable record of the medical knowledge of this early period has been handed down to us.

The manuscript consists of 188 paragraphs, which include some most interesting information on anatomy, physiology, medicine, surgery, pathology, materia medica and therapeutics.

The first part deals with the treatment f various diseases, such as pneumonia, evers, ascites, peritonitis, and many others. The surgery is of a somewhat advanced haracter. The general practice seems to ave been to attempt the removal of any umour or diseased condition, first by drugs aken internally or applied externally, and vhen these means failed, to resort to the nife or the cautery. Lithotomy and repanning the skull are specially mentioned, nd ligaturing hæmorrhoids was practised. The following examples are of some of the phorisms given in the manuscript:—

> "There are three bones in a man's body which when fractured will never unite again, and neither of these exists when a man is born, namely, a tooth, the knee-pan, and the os frontis."

> "The physician's three master difficulties are a wounded mammary gland, a wounded knee-joint, and a wounded lung."

The materia medica mentioned in the nanuscript comprises about 175 plants, lowers, roots, etc., the list including oxglove, poppy, valerian, peppermint, proom, etc. The preparations of these vere generally in the form of infusions, lecoctions, pills, or ointments. In he latter part of the manuscript there is given a large number of recipes recommended for various complaints. The ollowing are examples:—

> "*For Eczema.*—An unguent of honey of ivy, fox-marrow and white resin.

BURIAL OF AN ANTIENT CYMRIC
CHIEFTAIN.

"*For Deafness.*—Ram's urine and eel's bile, and the juice of ash, and express into the ear.

"*For a Punctured Wound.*—Take the dung of a bull and apply thereto.

"*To induce Sleep.*—Take poppy heads, bruised in wine.

"*For Falling Sickness.*—Burn a goat's horn, directing the smoke upon the patient, and in consequence of the smell, he will forthwith rise. Before he has risen from the ground, apply dog's gall upon his head, and the disease will not attack him any more."

The physicians of Myddfai laid down a egular course of hygiene, in which an nema or an emetic was recommended to be sed every month.

Rhiwallon and his sons first became hysicians to Rhys Gryg, lord of Llan-overy and Dynevor Castles, who gave hem rank, lands, and privileges at Iyddfai for their maintenance in the ractice of the art of healing, and for the enefit of those who should seek their help. Their fame soon spread, and their ervices were in demand throughout the ountry.

The descendants of this antient family f physicians continued to practise medicine n Wales without a break until the middle f the eighteenth century, when the last neal descendant of the family died, in 743.

A distinct advance is shown in the nowledge of medicine in another early ymric manuscript, said to have been ompiled by Howel the Physician, who vas a son of Rhys, who was a son of

Double Cromlech at Plas Newydd in Anglesea.

Cromlech in Anglesea.

WELSH CROMLECHS OR DOLMENS

Some very fine cromlechs still exist in Wales, the uses of which have been differently explained. One belief is that they are the remains of great stone altars upon which human sacrifices were offered in the mysterious druidic rites, another that they were monumental memorials, marking the burial-places of heroes of a period even anterior to that of the Cymric chiefs.

Llewellyn, who was a son of Philip the Physician, who was a lineal descendant of Einion.

A large portion of this manuscript is devoted to dietetics, and includes a table containing many quaint directions for the regulation of diet in health and disease. Emetics, purgatives, suppositories, and cordials are frequently recommended, and baths of various kinds are mentioned. Bleeding was recommended occasionally, and local applications, such as poultices and counter-irritants, are frequently alluded to.

The exact date of this manuscript is not known, but it was probably written about the end of the fifteenth century. The work is divided into about 815 paragraphs, and begins with a number of conjectures as to the exciting causes of various diseases, such as the following :—

"Fever is excited by excess of heat and cold."

"Eruptive poison in the blood, or tumours, are produced by irregularities of eating and drinking, obstructions in the stomach, veins, or other hollow vessels of the body, so that the food, drink, blood, or humours cannot pass on as usual."

"A boil or carbuncle, or plague, are occasioned by the entrance of poison into the system."

"From these proceed all fevers and diseases incident to the human body, and by the aid of active remedies they are cured."

Gout was attributed to a "desiccation of humours into a calcareous earth." Paralysis was said to be due to the blood becoming

THE ORIGIN OF THE BROAD ARROW.

The above antient Cymric symbol, called the "three rods or rays of light," signified the eye of light, or the radiating light of intelligence, shed upon the druidic circle This symbol was appropriated by King Edward III, and adopted as one of his badges It was also borne by his son, the Black Prince, and by other Princes of Wales. The Broad Arrow occurs as a mark of the royal household as early as 1386, and after 1693 was used as a mark for Government stores

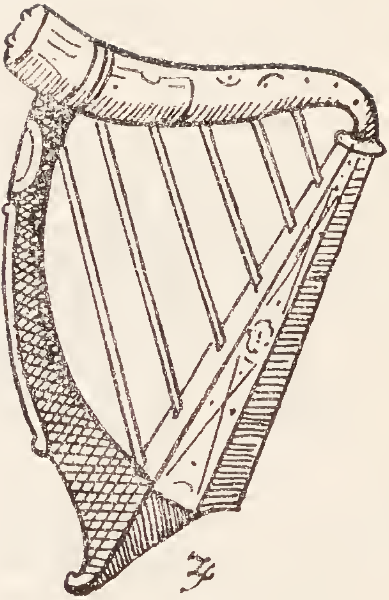
ıggish or viscid in the veins. Brain ver was stated to be occasioned by water ıder the fontanelle pressing upon the brain ıd membranes. Consumption was reırded as due to an eruptive poison in the ood.

In this manuscript are mentioned eight ındred plants, flowers, roots, etc., many which are used in medicine at the resent day. Among the inorganic subances, sulphate of copper, alum, mercury, ılphur, antimony and lead were employed. f the recipes given in this manuscript, the llowing are some curious examples:—

"*For Worms in Children.*—Take the ıild's hair; cut it as small as you can, and ix as much as will stand on a golden crown ith the pulp of a roasted apple or with ɔney. With this you will kill the worm."

"*To Extract a Tooth Without Pain.*—ake some newts, by some called lizards, ıd those nasty beetles which are found in rns in the summer time. Calcine them an iron pot, and make a powder thereof. Vet the forefinger of the right hand, and sert it in the powder, and apply it to the ɔoth frequently, refraining from spitting off, when the tooth will fall away without ain. It is proven."

"*For Pain in the Eye.*—Take the gall a hare, of a hen, of an eel, and of a ag, with fresh urine and honeysuckle aves, and then inflict a wound upon an y tree, and mix the gum that exudes from ıe tree therewith, boiling it quickly, and raining it through a fine linen cloth. Vhen cold, insert a little thereof in the ɔrner of the eye, and it will be a wonder



THE WELSH HARP.

"Telyn awr Telynoriou."
(The Golden Harp of the Harpers.)

Only three musical instruments are known to have been used by the antient Cymry, the crwth (rude violin), the pibcorn (hornpipe) and the harp. The earlier Triads specify "the playing of the harp" as one of the three signs distinguishing a freeborn Briton from a slave. Giraldus states, that the antient Britons "greatly excelled all western nations not only in harmony but also in the ingenuity of their songs and extemporizations."

he who makes use of it does not see the ars in mid-day in consequence of the irtues of this remedy."

"*For Stranguary and Stone.*—Take the lood and skin of a hare and make a powder hereof; mix with the cyder of red-rinded pples, mead, or beer, and drink it with ither. Let the patient drink this only, and will disintegrate the stone, causing it to e expelled. If you should wish to prove his, take a spoonful of this powder with ater, and put it in a hole made in an acid one, and by next day it will certainly have issolved it."

"*An Ointment for General Use.*—Take gander's fat, the fat of a male cat, and a ed boar's fat, and three drams of blue wax upriated wax), watercress, wormwood, he red strawberry plant, and primrose. oil them in pure spring water, and when oiled, stuff a gander with them, and roast hem at a distance from the fire. The rease issuing from it should be carefully ept in a pot. It is a valuable ointment or all kinds of aches in a man's body, and like one that was formerly made by Iippocrates. It is proved."

"*To Clean the Eye.*—Obtain some fresh rats, and lay them in the sun or at such a istance from the fire as will subject them a like heat, till an oil exudes therefrom. Iix this oil with honey, and anoint your ye therewith."

"*To Procure Sleep.*—Boil poppy heads n ale, and let the patient drink it, and he vill sleep."

The preparation of cod liver oil was ractised at this early period by the Welsh

THE ANTIENT WILD GOAT OF WALES.

"Not for Cadwalladr and all his goats."—
Shakespeare (*Henry V.*)

The mountains of Wales were once the stronghold of an exceptionally fine race of wild goats, which formed a valuable source of milk and meat supply (côch yr wden = hung goat-venison) to the antient Cymry. Pennant, the Welsh zoologist, mentions one with horns 3 ft. 2 inches long, and measuring 3 ft. from tip to tip. Some fine specimens of the wild goat are still found in Glamorganshire.

physicians, as may be judged from the following recipe :—

"*To Make a Cerecloth.*—Take two ounces of cod oil, two ounces of pitch, two and a quarter ounces of mastic, and one ounce of frankincense. Mix them well together and set on the fire, taking a quantity of plantain juice and mixing therewith. Put the cloth in this molten fluid, so that it may absorb as much as possible thereof. Then set aside to cool, warming it by the fire when required, for a bruise or other injury on a man's body."

Towards the close of the manuscript, a list is given of the "essentials of a physician :

"1. A lancet to bleed or open an abscess ; also a knife somewhat larger."

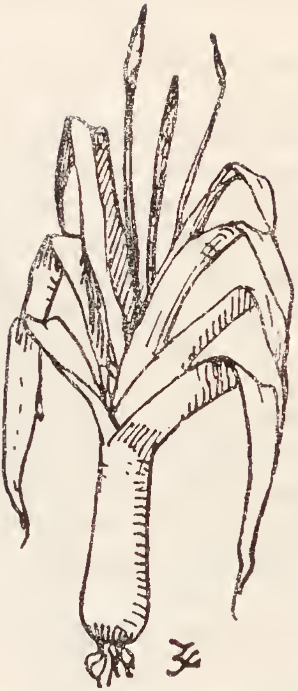
"2. A steel or silver spatula to spread a plaster."

"3. A pipe and a bladder to inject to the urinary organs or rectum."

"4. His plasters, his ointments, his pills, his powders, his potions, carefully preserved to meet any demand and occasion."

"5. A garden of trees and herbs, where such herbs, shrubs, and trees as do not everywhere grow naturally, may be kept cultivated, and where foreign trees and plants which require shelter and culture before they will thrive in Wales, may be grown."

Some excellent advice is given to the young physician. He is exhorted to be a kind man, gentle, mild, meek, intelligent, wise and gentlemanly in act and deed, in word and conduct, being careful not to



THE LEEK OF WALES.

(A MEMENTO OF ST. DAVID'S DAY.)

An old rhyme says of St. David :—

"He did only drink what crystal waters yield,
And feed upon the leeks he gathered in the field ;
In memory of which, in the revolving year,
The Welshman on that day the sacred herb doth wear."

Tradition tells us that upon St. David's Eve, A.D. 640, a king of South Wales discovered that a Saxon army was about to attack him, the soldiers disguised as Welshmen. He enjoined his followers each to pluck a leek from an adjoining field, and wear it as a distinguishing mark, and the king obtained a signal victory upon the morrow. Shakespeare makes Fluellin explain to Harry of Monmouth the custom of wearing the leek by a Welshman on St. David's Day "which, your Majestie knows, to this day is an honourable badge of service."

ame those whom he has to examine, par-
:ularly when he has to examine women.

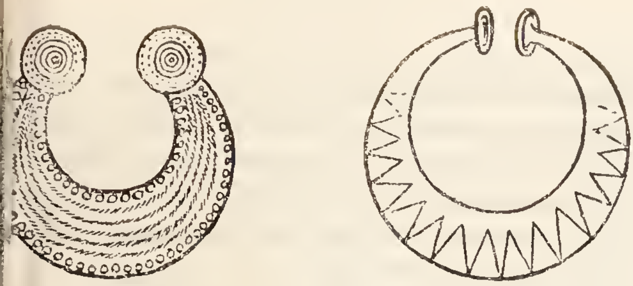
" He should always have his case of in-
ruments, emetics, and antidotes about him
case of need. He should be constitu-
onally and habitually devotional, so that
e blessing of God may be upon him and
hat he does, and that he may be con-
ientious to do what is right and beneficial
the practice of his art."

A careful study of this interesting manu-
ript shows that the art of medicine
ractised in Wales in the 15th century was
rther advanced, and was freer from the
fluence of superstition, than in most
uropean countries at that period.

Medicaments were evidently prepared
ith care and attention and their properties
sted, some crude attempts being made to
nalyse the symptoms of disease before
mmencing treatment.

Before entering upon the practice of his
rofession, the young medical man was
xpected to submit to a careful preliminary
aining and final examination, "so that
e (as physician) may be skilled in the
dgment and science of the wise and
kilful physicians who have preceded him."
he advice and axioms laid down for the
uidance of the practitioner prove that the
leals of these early Cymric fathers of
edicine were lofty, and their knowledge in
dvance of the times in which they lived.

DRUIDICAL WORSHIP.



Druidic breast-plates.

Druidic Beliefs.

[M]EDICINE, astronomy, and religion were [in]timately associated by the Druids. They [b]elieved that the soul was eternal, and that [th]e stars were worlds successively inhabited [b]y spiritual emigrants from the earth. [T]o the appearance of the moon they gave [s]pecial study, and believed that it was a body like the earth with mountains and other similar features, and that it was the residence of happy souls. The moon to them was the place and visible pledge of immortality. For this reason it occupied a high position in their religion, the order of all their festivals being

Representations of Sun, Stars, and the Constellation of the Watering Pot, on an antient Gaulish coin.

[ar]ranged to follow the day which was [de]dicated to it; its presence was sought in [all] their ceremonies, and its rays were [in]voked. Thus, owing to their reverence [fo]r the lunar body, the Druids are generally [re]presented with the crescent in their [ha]nds. To the moon they appealed in [tim]es of difficulty and trouble. Thus [Ta]citus speaks of the Romans having been

strenuously opposed in Wales by arme Britons, headed by Druids, who, "liftir up their hands to the heavens from tl high mountain peaks, invoked their god and poured curses on the invaders, strikir terror for a while into the hearts of the Roman soldiers."

Representations of Sun, Moon and Stars on an antient Gaulish coin

"So strong was their conviction of the future life in the planets," states Pomponius Mela, "that it was customary among the Druids to lend money to be repaid in the next world."

The Druids supposed that when th circle of the moon was complete, fortun promised to be most propitious. The wor *rath*, which in Gaelic means a wheel or circle also signifies fortune. The Druids believe in the influence of th moon on man as well a on inanimate objects The waxing, the full or the waning moon was emblematical o prosperity, establishec success, or declining fortune, and by th phases of the moon th periods for commenc ing important under takings were regulated

Representations of a Constellation and Time on an antient Gaulish coin.

The stars and other heavenly bodies were also reverenced, though in a lesser degree. The Milky Way wa thought to be the town of Gwyon, the geniu

f which, called Dow, was believed to reside ı the constellation of Cassiopeia. Another ıythical being, called Arthur, had for his welling the Great Bear, which the Druids alled "Arthur's Chariot."

Further evidence concerning the astron-my of the Druids is furnished by numerous oins that have been iscovered belonging to ıe old Gauls, who rere of the same stock s those who culti-ated Druidism in ritain.

Representations of Sun and Great Bear on an antient Gaulish coin.

On some of these oins and medals are to e found astronomical ymbols, such as the ın, moon, the sun-orse, the bear, and arious constellations. everal of these signs ppear to have been borrowed from the haldeans and Egyptians, and probably rere communicated to the Druids by the hœnicians. The concentric pointed ircles, the crescent with a globule or a tar, and the line in zigzag were used in gypt to symbolise the sun, the month, ıe year, and water, and they appear to ave had the same significance among the Pruids.

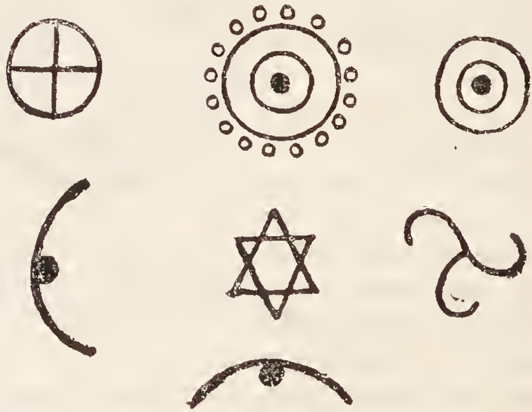
Again, other signs, such as that here

illustrated, and its multiple combinations, the centred circles, the globules or rings, the alphabetical characters ecalling the form of a constellation, and ıe wheel with rays, are all represented on

bronze arms found in Celtic, Germanic, an
Scandinavian lands.

The curious custom of impressing thei astronomical ideas upon their coinage i not peculiar to the Western nations alone for in China, Korea and Japan, coins of similar description have been met with, o which are impressed the signs of the Zodiac

In the ceremonies of the Druids, invoca tions were addressed to the sun, moon



Druidic Symbols of the Sun, Moon, etc.

stars, and other visible phenomena, but above Nature there was believed to be the great generating and moving principle which the Celts placed, at a later period perhaps, among the attributes of their supreme deities.

"Their knowledge of astronomy was such," says Toland, "that in one of their temples in the Island of Lewis every stone is placed astronomically correct."

A kind of glass or vitreous substance, that has been found in the cairns, shows that the manufacture of glass was not unknown to

he Druids, which knowledge they probably cquired from the Phœnicians.

Among the deities venerated by the Druids were Mercury, who was regarded s the inventor of the arts, Apollo, Mars nd Jupiter.

The cube was used by them as the

symbol of Mercury, and also to signify truth, while the tallest and fairest oak-tree in the wood was consecrated to Jupiter. With the eneral consent of the whole order, the Arch-Druid fixed on the most beautiful oak-tree n the grove, and then performed the rite of consecration. All the side branches aving been first cut off, he proceeded o join two of them to the highest part of he trunk, so that they extended on either ide like the arms of a man, and ormed in the whole the shape of cross. Above the insertion of hese branches, and below, they

nscribed in the bark of the tree the word "Thau," and before it performed their nost sacred rites.

Of all trees the oak appears to have been eld in the highest veneration by the Aryan ace. It ranked among the holy trees of he Germans, and was, indeed, their chief leity, distinct traces of its worship having urvived almost to the present day. To the ncient inhabitants of Italy the oak was acred above all other trees. The image of Jupiter Capitolinus at Rome, according to Livy, was nothing but a natural oak tree. The civic crown of the Romans was of oak, and a chaplet of oak was the reward of eminent services rendered to the State.

The Greeks worshipped Zeus as residing

in the sacred oak at Dodona, and the rustling of its leaves was supposed to be his voice. According to the belief of the ancient Greeks, acorns formed the staple food of man till Demeter introduced corn. Boughs of oak were therefore carried in her mysteries at Eleusis.

The Druids were adepts in magic, and especially in divining. The most solemn rite of divining was performed by examining accurately the entrails of sacrificed victims, and so judging by their appearance if the gods were favourable or not. They also divined from the fall and convulsion of the limbs, and from the flow of blood immediately after the victim had received the fatal blow.

They predicted future events by gazing into holy wells and running streams, after these had been stirred by the branch of an oak-tree, or by a magic wand.

The first of November was regarded by the Druids as the night of mystery. On this occasion they annually celebrated the reconstruction of the world. A terrible rite was connected with this celebration, for the Druidic nuns were compelled at this time to pull down and rebuild each year the roof of their temple, as a symbol of the destruction and renovation of the world. If one of them in bringing the materials for the new roof allowed her sacred burden to fall, she was lost. Her companions, seized with fanatic transport, rushed upon her, and tore her to pieces, and scarcely a year is said to have passed without there being one or more victims. On the same night the Druids extinguished the sacred fire, which was kept continually burning in the

holy precincts, and at that signal all other fires were one by one put out, and the thick darkness of primitive night reigned throughout the land. Then passed along to the West the phantoms of those who had succumbed during the preceding year, and were carried away in boats to the judgment-seat of the God of the Dead.

The Dragon of Wales

"*Cambria, I love thy genius bold,*
Thy dreadful rites and Druids old,
Thy Bards who struck the sounding strings,
And waked the warlike souls of kings.
I love thy fair Silurian vales
Fanned by Sabrina's temper'd gales,
That lured the Roman to engage
The scythed cars of Arverage."

Ode to Cambria.

DRUIDS UNSHEATHING THE SWORD

Druids performing an antient ceremony. The great sword of the

THE . . . . . CHRONOLOGY . OF THE . . . CYMRY . . . .

It is stated that the original home of the Cwmry, Cumri, or Cymry, was in Southern Hindustan, the southern extremity of which, Cape Comorin, takes its name from the same root. The meaning of the Sanscrit word "Kumari" is a youth, a prince.

The following, also, is an interesting example of the agreement of Cymraeg with the Hebrew language:—Hebrew: "Byllang adonai-eth cal nêoth Jangeob." Cymraeg: "By-llw-ng adon-ydh holl neuodh Jago." English: "The Lord hath swallowed up all the habitations of Jacob."—Lam. ii. 2.

1st King of Ynys Pridhain, "Britain, the Beautiful Isle" (according to the Welsh Triads) ... about	1000 B.C.
Britain, standing on the edge of the then known world, mentioned by Herodotus as Κασσιτερίδες, "the Tin Islands"	450 B.C.
Britain mentioned by Aristotle as βρετανικαὶ Νησοι "the British Isles"	320 B.C.

Caractacus (Caradog) led captive to Rome	A.D. 51
Bran, "The Blessed," after a visit to Rome, said to have introduced Christianity into Britain	,, 52
The "Gwelig Ruler" or "Over King" succeeds the Roman *Dux Brittanniarum*, and assumes the cognizance of "The Dragon of the Great Pendragonship" ... about	,, 420
Many of the antient Britains driven into Wales by the Romans	,, 447
Taliesin, one of Britain's greatest bards flourished about	,, 520
St. David (Dewi Sant) elected Primate of Wales, founds monastery at Mynyw (St. David's) and moves the Primacy thereto from Caerleon	,, 544–601
The Antient Eisteddvoddau restored, with the motto, "Y gwir yn erbyn y byd" ("The Truth against the World"), subsequently formally sanctioned by Queen Elizabeth, 26th May, 1568 ... about	,, 550
Death of the great Cadwalladr	,, 688

Rhodri Fawr (Roderick the Great) keeps Saxondom at bay, but the Welsh chiefs ultimately acknowledge the sovereignty of Alfred the Great	A.D.	750–885
Howel Dha of Dyfed (Pem.) codifies the Welsh laws ...	,,	930
Gruffydd ap Llewellyn becomes King of North Wales	,,	1039
Harold invades Wales and places a Saxon colony on the Radnor side of Offa's Dyke	,,	1063
After centuries of strife Celt and Saxon unite to oppose the Normans	,,	1066–1100
The Normans invited to assist internecine warfare in South Wales and gradually effect footing therein	,,	1087
The "Chansons de Geste" (Ballads of Knightly Adventure) of the Troubadours contain the earliest references to Merlin, the Prophet, and King Arthur and his Round Table, together with the "Quest of the Holy Grail"	,,	1150
Henry II. subdued Wales ...	,,	1157
The antient British Church, after centuries of dispute (under about 30 Welsh		

St. David (Dewi Sant), the patron Saint of Wales, is believed to have been of royal descent, and is said to have crowned King Arthur. His election to the archbishopric of Wales, some years before the arrival of St. Augustine, marked important progress in the missionary march of Christianity amongst the Cymry.

THE EVOLUTION OF ANTISEPTIC SURGERY

AN HISTORICAL SKETCH
OF THE USE OF
ANTISEPTICS FROM THE EARLIEST TIMES

LECTURE MEMORANDA

South African Medical Congress

CAPE TOWN

1910

BURROUGHS WELLCOME & CO.

LONDON

NEW YORK MONTREAL SYDNEY MILAN SHANGHAI

AND

5, LOOP STREET, CAPE TOWN

INDEX

FOREWORD

FOR many years I have been engaged in researches respecting the early methods employed in the healing arts, amongst both civilised and uncivilised peoples. It has been my object, in particular, to trace the origin of the use of remedial agents. Why were certain substances used in the treatment of various diseases? Was their adoption the result of study and practical observation, or was it more usually the result of accident? Were the alleged virtues purely imaginary and due to some superstitious suggestion? A consideration of such questions is always of interest, and sometimes adds to our knowledge.

There is a considerable amount of information scattered throughout the world in folk-lore, early manuscripts and printed books, but the difficulties of tracing out and sifting the evidence are considerable. I anticipate that the Historical Exhibition of medical, chemical and pharmaceutical objects which I am organising, to be held in London will lead to the revealing of many facts, and the elucidation of many obscure points, in connection with the origins of various medicines.

I should greatly value any information sent me in regard to medical traditions or references to antient treatment in manuscripts, printed works, etc.; even though the items be ever so small, they may form important connecting links in the chain of historical evidence.

It is my intention ultimately to place before the profession, in a collected form, all the information I obtain.

HENRY S. WELLCOME

Surgeon Bandaging a Patient after an Operation

The Preparation of Mummies. From an Antient Egyptian Tomb

The Evolution of Antiseptic Surgery

An Historical Sketch of the Use of Antiseptics from the Earliest Times

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Synopsis of Chapters

CHAPTER I

Antiseptics: Natural and Prehistoric

The necessity of preventing putrefaction in dead matter appears to be instinctive among certain animals and insects, and many living things are known to protect themselves by various ingenious methods from destructive septic influences. An instance of this natural instinct may be taken from the life of the bee. Should an intruder, in the form of an insect or moth, make its way into the beehive, it is speedily killed and ejected. Should, however, this be impracticable, owing to its

Natural antiseptic of the bee

St Roch + the Angel

Dog Licking a Wound, and an Angel Applying a Dressing to the Same

From a woodcut of the XV century

position or size, the body of the intruder is impregnated with, and preserved by, the formic acid secretion of the sting, and putrefaction thereby prevented. It is then methodically and hermetically enclosed in a sepulchre of wax, so that, it being excluded from the air, the bees in the hive are protected from septic influences.

Naturalists also tell us, that when dealing with snails that have made their way into the hive, the bee is content to seal up with wax the orifice of the shell, and so utilise the intruder's equipment as its own tomb. As we shall see later on, man apparently borrowed this idea of preserving bodies from putrefaction from the bee, for we find that honey was used by the Greeks to protect the body from decay, and was also employed by them as a dressing for wounds.

In connection with the poisonous products of putrefaction, it is a curious fact that certain birds of prey, like the vulture, appear to be immune from their evil effects, and can eat with impunity large quantities of diseased and putrefied animal tissue.

Other birds appear to possess a remarkable instinct for surgery, which is even accompanied by a natural antiseptic treatment. Expert naturalists have observed that the woodcock and partridge are able to dress their own wounds with considerable skill. It was noticed in the case of several woodcock which were shot, that they were recovering from wounds which had been previously received. In every case the injury was found to be neatly dressed with soft down plucked from the stems of feathers, and skilfully arranged over the wound, evidently by the aid of the long beak of the bird. In other cases, it was observed that ligatures had been applied to wounded or broken limbs. Certain animals, when wounded, have been known to burrow into the earth or mud, and so shield the wounded part from the air.

The surgical instinct of birds

It is a matter of common knowledge that an animal, when wounded, will immediately commence to lick

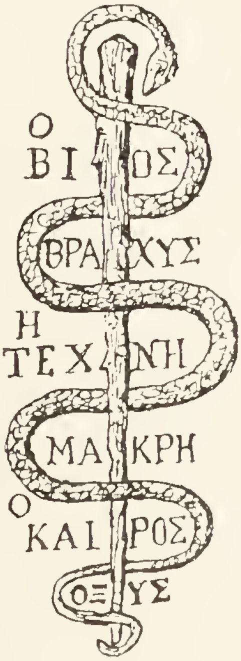
Asklepios

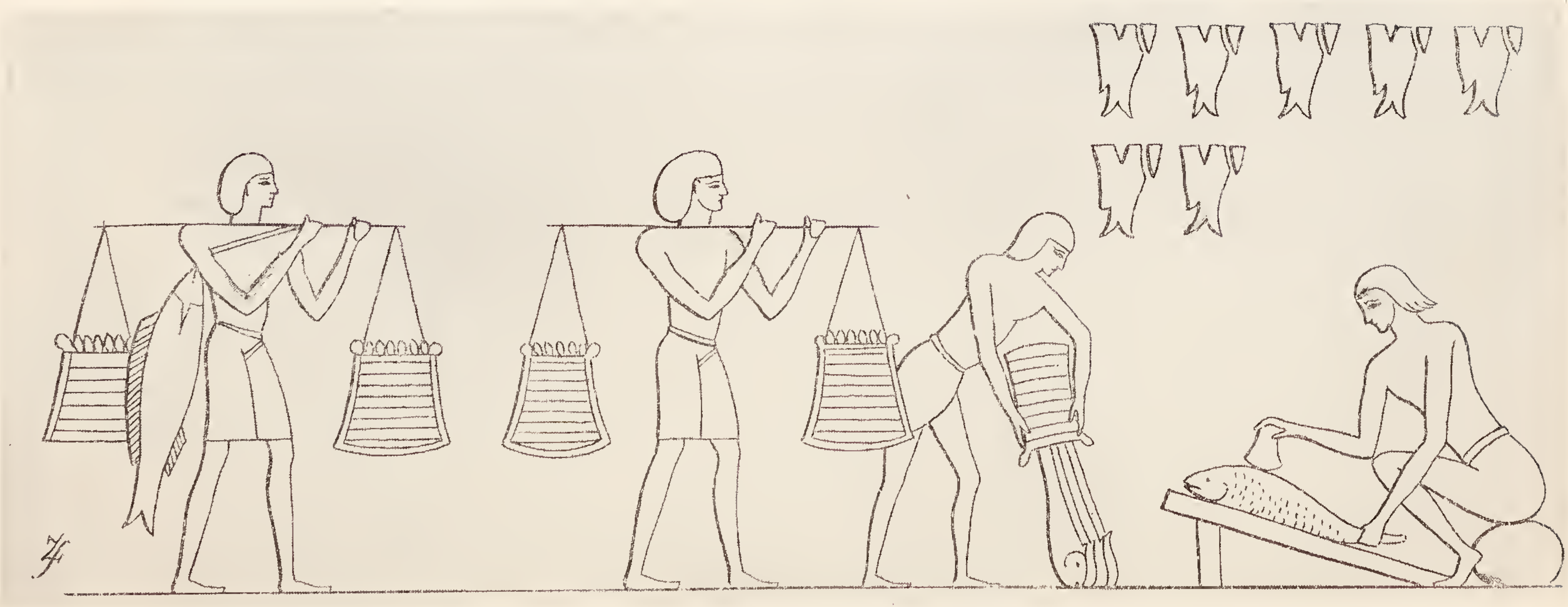
Hygeia feeding one of the Sacred Serpents of Asklepios

the cut or laceration, and often, without other care, such wounds heal in a remarkably short space of time. By the act of licking, the wound is cleansed, and it is quite probable that, owing to the salts in solution in saliva acting as a natural antiseptic, the frequent application of the tongue assists the healing of the wound. Curiously enough, this natural method of healing was perpetuated in the temple of Asklepios at Epidaurus, in Antient Greece, where the sick and suffering who came to be healed, had their wounds and sores licked by the sacred serpents which were kept for that purpose. These serpents, which were of a harmless variety found in the valley of the Hieron, are said to have been trained to lick with their forked tongues the ailing part. Asklepios, the deity himself, was supposed sometimes to appear in the form of a serpent, and was generally represented with a staff around which a serpent is entwined, an emblem which is still recognised as pertaining to the healing art.

Animal instincts in healing wounds

The serpent as a medical symbol





Antient Egyptians Preserving Fish by Salting and Drying

CHAPTER II

ANTISEPTICS IN THE EARLY AGES

Although man appears to have been more backward than the lower animal creation in recognising the danger that menaced him from the putrefaction of matter, we find that philosophers and seers from the earliest times have speculated as to the cause, and attempted to solve the mysteries of the natural processes attending decay. When these early observers saw, that after a while dead matter became alive with minute animals, they concluded that there was a re-conversion of dead into the living. The decay of one body was but the generation of another. Thus they eventually arrived at the belief, that the living forms were but the adaptations of the elements of dead matter, and that even rats and snakes were created spontaneously from the earth.

Man's first theories on putrefaction

It is probable that the first occasion that suggested to primitive man the necessity of preventing decay, arose from the desire to preserve animal tissue for food. The earliest method probably employed by him for this purpose was the simple and primitive process of drying. He doubtless found from experience that, if this was completely carried out, it prevented the ordinary putrefactive changes taking place. In hot and dry countries this method seems to have been extensively practised from the earliest times, and in this way the prehistoric inhabitants of Egypt originally preserved the bodies of their dead.

Earliest methods of preserving, employed by man

Smoking was also employed as a preservative in the Early Ages, and has survived to the present day as a method for curing fish, pork, and other animal substances. The preservative properties of smoking, as now practised, are well known to be due to the antiseptic action of the creosote present in the smoke from the wood which is employed in the process.

Smoking as a preservative

Refrigeration, by means of which animal matter, when kept at a low temperature, is enabled to resist putrefaction, and which is now so largely employed in the importation of meat, is but an adaptation of Nature's processes. This is clearly illustrated by the carcases of long extinct mammoths which have been discovered in the ice cliffs of Siberia with flesh still upon them.

The antiquity of salting as a preservative

The preservation of animal matter by natural salts, such as the chlorides and nitrates of sodium, has, with little doubt, been employed from the Early Ages. The preservation of fish in this manner was practised in antient times by the Egyptians, and also by the early races inhabiting Scandinavia and the north of Europe.

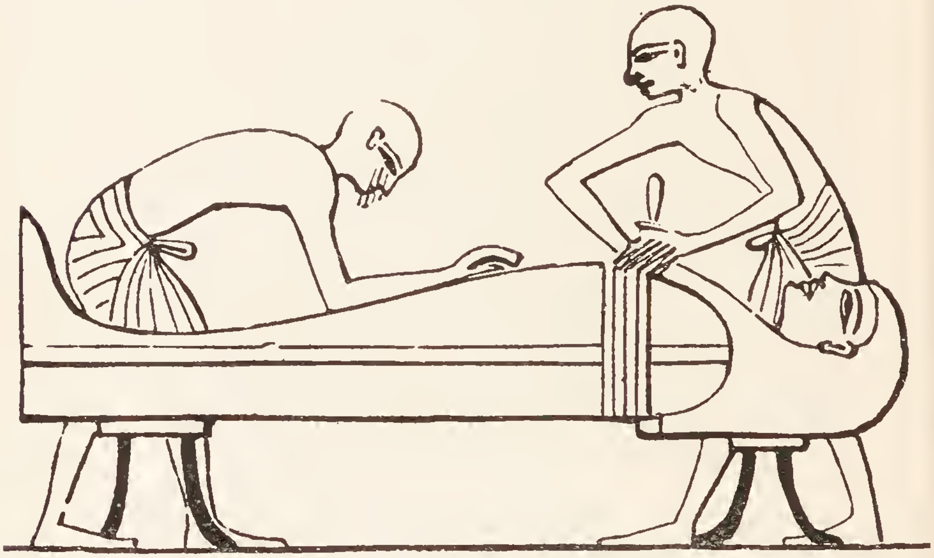
Earliest method of embalming

The custom of embalming, or preserving the human body from decomposition, goes back to a period of great antiquity. The method employed by the Egyptians in prehistoric times is said to have been carried out by first slowly drying the body and then washing it with a strong solution of natron, the natural carbonate of sodium found in Egypt.

Antient Egyptian methods of embalming

At a later period, a more elaborate process of embalming came into vogue, which was performed by means of the insertion of certain oils, gums and resins into the cavity of the body, after the moister portions had been removed. Finally, the body was washed with oil of cedar and natron. Another method of embalming, practised by the Egyptians, was carried out as follows: the brain and intestines were first removed, after which the abdomen was washed clean with palm wine and then filled with myrrh, cassia and other aromatic gums and gum resins. The body was then soaked for seventy days in a solution of natron, and was finally bandaged with gummed linen or cloth. In some processes, a liquid distillate of pitch-pine was used, also tar, bitumen and asphalt. It should

be noted that practically all the substances, employed by the early Egyptians in their processes of embalming, possessed antiseptic properties to a greater or lesser extent.



ANTIENT EGYPTIANS EMBALMING A BODY

The early Ethiopians used a diaphanous resin to preserve the bodies of their dead from putrefaction, whilst the Persians enveloped theirs in wax.

Recent light on Egyptian methods of embalming

From a recent investigation carried out at the Government School of Medicine in Cairo, it is stated on scientific evidence, that the early Egyptians simply pickled the bodies of their dead in brine, and that the various aromatic balsams and resins employed, were mainly accessories to the process. The real agent at work was the extraordinarily dry climate of the country.

It has been calculated that in Egypt alone seven million bodies were embalmed, yet the idea of applying the principle of preventing putrefaction in other ways never seems to have occurred to the peoples of the early civilisations.

About the third or fourth century before the Christian era, honey appears to have been largely employed for preserving the bodies of the dead from putrefaction. Columella speaks of the pro-

perties of honey in preserving bodies for several years, while Lucretius also refers to its power of preventing decay. Josephus records, that the Jewish king Aristobulus, whom Pompey's partisans destroyed by poison, lay buried in honey till Anthony sent him to the royal cemetery in Judæa. The Assyrians are also stated to have placed the bodies of their dead in honey to preserve them from corruption.

The employment of honey in embalming

Abd'Allatif relates a story of "a man who had found a large sealed cruise, and having opened it, he discovered it to contain honey, which he began to eat, until one of his companions observed a hair upon his finger. When the contents of the vessel were more closely examined, the body of a little child, quite perfect, was withdrawn from it. The body was well preserved and decorated with rich jewels and ornaments." The dead body of Alexander the Great was rubbed and embalmed with honey, and the practice of using honey for embalming purposes seems to have been common amongst Romans of the higher class. Virgil alludes to the practice in the following lines:—

> Grant the corse torn by ravening fangs a curse,
> Is hence no ill in funeral flames to burn ;
> Or, pent in cold obstruction, stiffening lie
> Immers'd in *honey*, while entombed in stone.

Wax also appears to have been extensively employed at this period for preserving the dead from putrefaction. The body of King Agesilaus was thus preserved during its conveyance from Sparta to Lacedemon for burial. This story is confirmed by Cornelius Nepos and also by Plutarch, who ascribed the adoption of wax to the want of honey for this purpose. It can be readily conceived how the coating of a body with wax under certain conditions would hermetically seal the dead tissue and keep it from contact with the air, and so prevent for a time the process of putrefaction taking place.

The use of wax in embalming

The Guanches, the aboriginal inhabitants of the Canaries, practised a method of embalming similar to that of the Egyptians.

The method which they employed is described by an antient Spanish writer as follows: "They carried the dead body in a case, stretched it out on a flat stone, opened it and took out the bowels; then twice a day they washed the porous parts of the body, namely, behind the armpits, behind the ears, the groin, between the fingers and the neck, with cold water. After sufficient washing, they anointed those parts with sheep's butter, and sprinkled them with a powder made of the dust of decayed pine trees, and a sort of brushwood which the Spaniards called 'Bressos,' together with the powder of pumice stone; then they let the body remain until it was perfectly dry, when the relatives came and swathed it in dressed goat-skins, girding all tight with thongs of leather. The body was finally placed in a cave. In some cases amongst the Guanches, the cavities of the body, after being washed with salt water, were made to receive aromatic substances, and the whole body was then dried in the sun or in air artificially heated."

The body of King Edward I. ("Longshanks") was embalmed, in 1307, and the bill for medical attendance and embalming the body, which is not without interest, is still extant. The following items in the account relate to the embalming :—

	£	s.	d.
"Pro emplastris cironeis	4	0	0
Item pro terebintine destillato ...	0	40	0
Item pro uno emplastro pro collo Regis cum ladano et ambras orientalis	0	60	0
Item pro vj malis granates	0	60	0
Item pro sex unciis de balsamo ad corpus Domini Regis unguendes	13	0	0
Item pro pulveri aromatice de aloeis thuris myrrhæ ad ponendem in corpore Regis	4	0	0
Item pro musco uncia iij ad ponendum in membris Regis (a) ...	0	60	0

The embalmers, Master Nicolas, of Tynwycke (who, the King said, "was more learned and fit to have the

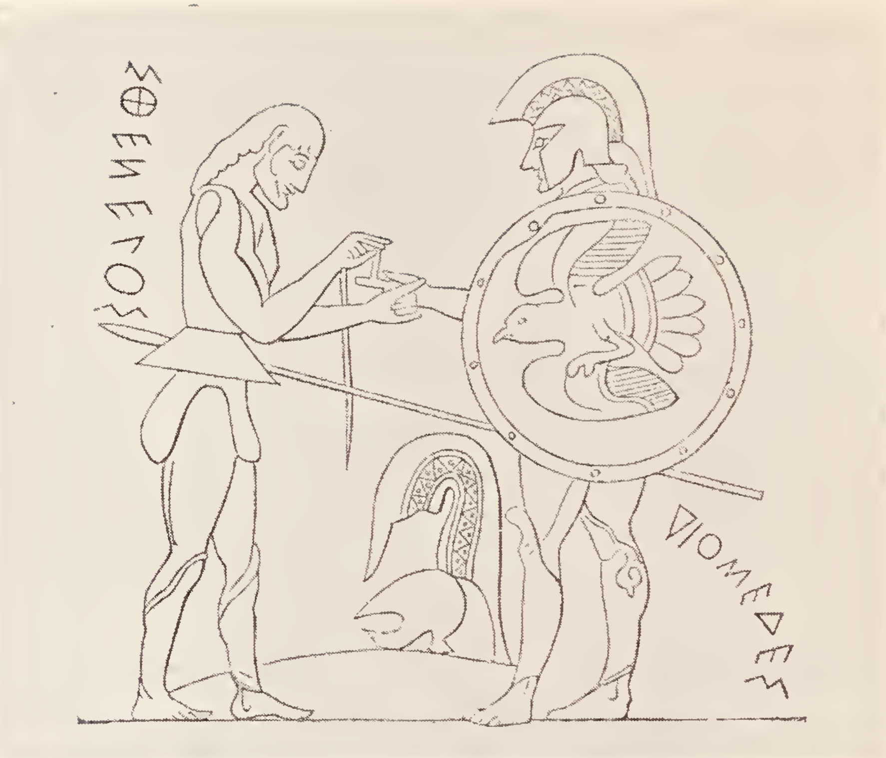
care of his health than anyone in the realm "), Master Peter, the surgeon, and Richard of Montpellier, the Espicer or apothecary, did their work well, for, in the early days of the present century, the tomb of Edward I. was opened, and the body found entire. An antiquarian enthusiast was induced to taste the "pickle" in which the royal remains were preserved, and even then, more than 500 years after the embalmment, it is said to have showed traces of the spices used, which are set forth in the account quoted.

Antient Hebrew antiseptics

Little can be gathered from the Old Testament as to the Hebrew method of treating wounds, but judging from the strictness of the hygienic measures enforced by Moses, the Jews recognised the danger that might arise from septicæmia and infection. According to the Levitic law, "the woman who gives birth to a male child shall be impure for seven days; if she gives birth to a girl, she shall be impure for two weeks." Among the substances ordered to be used in the process of purification were cedar, hyssop, and spring water, all of which possess certain antiseptic properties.

Early Hindu antiseptics

Sushruta, the Hindu father of surgery, in one of his works, advises that certain incense of aromatic drugs should be kept burning in the room in which an operation is being performed, with the presumed object of purifying the air.



Sthenelus dressing the wound of Diomedes

Greek Army Surgeon dressing the wound of a Soldier

CHAPTER III

Antiseptic Methods in the Grecian and Roman Periods

Antiseptics in Greek mythology

Coming to the Grecian period and the methods the Greeks employed in the treatment of wounds, Virgil describes how Diana, moved with pity at the sight of the sufferings of the son of Theseus, who was torn by his own horses, healed his wounds by the aid of certain medicinal plants. In the Georgics, he again alludes to the healing virtue of plants, and tells us how Japis, when tending Æneas, who had been wounded by an arrow, "squeezed into the wound the juice of certain useful herbs." Machaon, one of the sons of Asklepios, is said by Homer to have accompanied the army of Nestor. Although he took his place in the ranks with other warriors, he acted as military surgeon to the troops. The poet goes on to relate that when Menelaus was wounded in the leg, Machaon was sent for. He hastened to the stricken soldier, and withdrew the arrow. He sucked the wound and applied a softening ointment, the recipe for which Asklepios had received from the hand of Chiron. Machaon is also said to have healed Philoctetes of a foul ulcer by cutting out the wound, washing it with wine, and applying herbs of healing. The good effect of the wine was doubtless due to the antiseptic properties of the alcohol it contained. In the Iliad, an account is given of another battle, in which Machaon himself was wounded, and Polydorus, his brother, being engaged in fighting, Patrocles acted as surgeon and attended to Eurypylus, who was wounded by an arrow in the thigh. His method of treating the wound is thus described: he washed off the blood with lukewarm water, and took some bitter root, crushed it in his hand, and applied it to the wound; the blood stopped immediately and the pain ceased.

Wound treatment of Machaon, son of Asklepios

From this account, it appears that the antient Greeks were acquainted with some vegetable anodyne styptic which could be applied on the battlefield.

Greek Army Surgeon Dressing the Wounds of a Soldier

Antiseptics employed by Hippocrates

Hippocrates, the father of Greek medicine (460 B.C.), in his work on wounds, observes that the surgeon should aim at keeping the wound dry, that condition being a healthier one than when it is wet. He recommends that wounds should be permitted to bleed freely, and should be carefully cleansed. He was against the use of fatty substances as dressings, and advocated astringents, such as wine, alum dissolved in vinegar, galls, and the green bark of the fig-tree. He directs another dressing to be prepared by placing sour grapes in a vase of red copper in the sun, and adding honey, myrrh, nitre, and a small quantity of turpentine, thereby making an application which would possess undoubted antiseptic properties. In discoursing on wounds of the head, he states a head wound should never be moistened with anything, not even with wine, and alludes also to a black medicament, which is soluble, with which a wound might be anointed, and afterwards a piece of linen, moistened with oil, applied. To cure long-standing wounds, he recommends the employment of unfermented wine, to be used perseveringly, or astringent red or white wine.

Pitch and other tarry substances, having antiseptic properties, were also employed by the surgeons of early Greece in the treatment of wounds, and Pliny mentions how valuable were the absorbent properties of certain earths when used for the same purpose.

Oil and wine as a dressing for wounds

The antiquity of the use of oil and wine as a dressing for wounds is evidenced by the parable of the Good Samaritan, related in the New Testament. In pouring oil and wine on the wounds of the man, who was waylaid by robbers, the Samaritan was probably using the method of first-aid practised by his countrymen, which, unknown to them, was a mild form of antiseptic treatment.

Celsus, who lived about A.D. 50, gives us a glimpse of the methods of healing wounds employed by the Roman surgeons. Following the teaching of the

The Good Samaritan

Greeks, they first carefully cleansed the part by washing it with wine, vinegar, or oil. In other cases, honey was applied, or wool dipped in vinegar, and to arrest hæmorrhage, the wound was cauterised by means of a red-hot instrument. In a work on the second Punic war, by Silus Italicus, a surgeon who was present with the army of Hannibal, he mentions that wounds were cured with the juice of herbs and charms. The Romans were also acquainted with the properties of certain earths of a calcareous nature, which they used as an application to wounds.

Paulus Ægінetus, who flourished about the seventh century, advocated astringent applications, such as fir-cones macerated in wine, as a dressing for wounds.

Wound treatment in the Roman period

Galen, the famous Greek physician and anatomist, who flourished A.D. 200, employed as wound dressings, alum dissolved in wine, lime water and astringent herbs. Writing on alexipharmic dressings for wounds, he states, that they only take effect when they are contrary to the cause of the disease, so that according to the nature of the deleterious or venomous substance, a heating or refreshing remedy should be applied. Honey, hydromel, verdigris, turpentine, and oil were among the substances also recommended by Galen to be used in dressing wounds; but, before their application, he insisted that the wound which was putrid should be washed with wine. Another method he advocated was the application of a sponge or piece of wool, soaked in astringent wine, or a mixture of water and vinegar to the wound. For suppressing hæmorrhage, when cold water and astringents failed, he employed unripe galls and stronger wines.

Oribasius, another celebrated surgeon of the fourth century, followed the doctrines of Hippocrates, and strongly advocated the use of wine or vinegar, diluted with water, as an application to wounds. In some cases, he states he found that the leaves of the papyrus plant, which had previously been soaked in wine, were of great value in arresting hæmorrhage, and

thus he unconsciously devised a mild antiseptic plaster.

Rhases, the Arab, who lived between the years 850 and 923, and was probably the first to obtain alcohol by distillation of wine, employed it in the treatment of wounds, alone, or mixed with astringent plants.

A SOLDIER OF ANTIENT GREECE HAVING WOUNDED FOOT DRESSED

From a bronze ca. 250 B.C.

CHAPTER IV

Antiseptic Methods in Mediæval Times

In the early Middle Ages the teaching of the Greeks drifted southward, and the Arabian School added considerably to the knowledge of the period. Albucasis, the Arabian physician (A.D. 936–1013), in his treatise on surgery, recommends that a pad of cotton wool, soaked in rose oil alone, or mixed with an astringent wine, should be placed on a wound. "If the wound," he continues, "is found to be affected by the *action of the air*, an ointment should be applied until suppuration occurs." The fact that Albucasis in the eleventh century recognised the evil of exposing a wound to the air is very remarkable, and he may be fairly regarded as one of the earliest pioneers of what is known as aseptic surgery to-day.

Albucasis, the Arabian, observes the effect of the air on a wound

The methods of the Arabian surgeons and those who graduated at the School of Salerno were followed by Avicenna, Avenzoar, Averröes, and other famous surgeons of antiquity. The chief substances advocated by the School of Salerno for dressing wounds were aloes, centaury, galls, fennel flowers and other astringents, some of which remained in use for this purpose as late as the eighteenth century.

Wound dressing used at the School of Salerno

Another substance introduced by the Arab surgeons as a dressing for wounds, and which was employed for centuries afterwards in other countries, was the astringent gum-resin, called "dragon's blood." The origin of its use for arresting hæmorrhage was probably due to its colour, as, according to the old doctrine of signatures, substances of the same colour or shape as organs of the body, or its secretions, had a beneficial effect upon them.

From what is known of surgical treatment in Anglo-Saxon times, astringent substances, such as powdered galls, or the crushed leaves of some herb possessing styptic properties, were generally applied to a wound to arrest hæmorrhage. The treatment

for wounds employed by the Anglo-Saxon leeches may be judged from the following recipes taken from an Anglo-Saxon leech book, written about the seventh century :—

1. "A wound salve: take seed of waybread, bray it small, shed it on the wound; soon it will be better."

ALBUCASIS PERFORMING AN OPERATION

From an MS. of the XIII century

2. "For cleansing of a wound: take clean honey, warm it at the fire, put it then into a clean vessel, add salt, and shake it till it have the thickness of brewit, smear the wound therewith, when it turneth foul. If there be a bone breach in the head, pound maythe and goutweed well in honey, then add butter; that is a good salve."

3. "Again, a wound salve: the groundsel which

waxeth in highways, that is good for a wound salve, and ribwort, and yarrow and gith ripe; pound all the worts, boil in butter, and squeeze through a cloth."

Anglo-Saxon wound dressings

It is curious to note how, even in a country so far removed from Grecian influence as Anglia, we find honey being used as a dressing for wounds.

From Anglo-Saxon times to the twelfth century was the darkest period in the history of surgery, and, if anything, the art retrograded rather than progressed. Towards the close of the thirteenth century, however, Theodoric, Bishop of Cervia, near Ravenna, who was learned in surgery, gave voice to principles that eventually laid the foundation of aseptic surgery.

For centuries previous it had been believed and taught that the best method of treating a wound was to promote suppuration, and that every method should be used to keep it open, but Theodoric, writing in 1275, says: "It is not necessary, as Roger and Roland have written, and as many of their disciples teach, and as all modern surgeons profess, that pus should be generated in wounds. No error can be greater than this. Such a practice is indeed to hinder nature, to prolong the disease, and to prevent the conglutination and consolidation of the wound."

Theodoric in 1275 recognises the principles on which aseptic surgery is founded

Unfortunately Theodoric's theory was not believed, and the advocates of suppuration triumphed: for centuries afterwards, poultices and fats of various descriptions continued to be applied to wounds, and tents plastered with irritants to promote suppuration thrust into them, even when there was no foreign matter to be discharged.

The method of treating a wound practised by Theodoric and Henry of Mondeville, his pupil, was to wash it with wine only, scrupulously removing every foreign particle, and then bringing the edges together, and so excluding any form of dressing.

The favourite dressing of William of Saliceto, a physician who lived in the thirteenth century, was

a mixture of rose oil and the whites of eggs, which he applied to the wound by means of feathers.

Lanfranc's method of wound treatment

Lanfranc, the French surgeon, in 1265 improved on William's method of treatment, and observes that "a wound that will not close up by itself must be stitched with a needle through which a thread can pass. The wound should then be covered with the astringent powder of dragon's blood, taking care that it does not reach the inside of the wound, where it could prevent consolidation. Over this a linen cloth soaked in a mixture of rose oil and white of egg should be placed, and over this a bandage."

Early methods of dressing gunshot wounds

The invention of firearms as weapons of war, about the middle of the thirteenth century, opened up a new field for surgeons in the treatment of gunshot wounds. From contemporary writers we learn, that at the close of the fourteenth century their methods of treatment were still very crude. They believed that gunpowder was a burning irritating substance that poisoned the wound, and relied on the application of warm hemp-seed oil to counteract its harmful effects. Nicolaus, a German, who was barber-surgeon to the Duke Sigismund of Austria, was the first to introduce hemp-seed oil as a dressing for wounds. Gersdorff, an Alsatian surgeon, advocated pouring the oil into the wound, and insisted that it should be used two or three times in succession by pouring it out and filling the wound again. After this had been done, he substituted for the oil an infusion of the inner bark of the linden and elder blossoms, after which he applied drawing plasters.

Guy de Chauliac advocates the use of hot red wine

Guy de Chauliac, the great French surgeon of the fourteenth century, advocated the use of hot red wine to wash out a wound. After drying, he proceeded to dress it with a lenative ointment, over which he placed a bandage that had been soaked in wine and then squeezed. Around, but not on the wound itself, he

applied oil of rose and oil of myrtle mixed, or an application composed of oil and vinegar.

From the time of Guy de Chauliac, greater attention was paid to the treatment of wounds, judging from the writings of surgeons of the period. In them we find many new terms, such as "corrosive," "putrefactive" and "regenerative," frequently employed in connection with wound treatment. Such terms indicated a tendency towards a more scientific research and methodical study of the subject. Towards the middle of the century a remarkable paragraph occurs in a work by Arnauld de Villeneuve, a mediæval physician and alchymist, which apparently foreshadows the brilliant discoveries that were made centuries after his time. Writing on the means by which the healing of wounds is effected, he states: "sometimes washing is necessary. And such washing ought to be done with lukewarm drying agents, such as with wine or aqua vini (aqua ardenti). That such a washing ought to be dry has already been stated, for wounds are not cured unless previously dried. Wounds recently received, when they are washed with aqua ardenti, heal most speedily, because the liquid cleanses and dries and also *removes any harmful combination introduced from the air*."

Arnauld de Villeneuve uses alcohol as a wound dressing, and recognises a harmful combination introduced from the air

A very general belief prevailed in mediæval times in the preventive and antiseptic powers of certain plants possessing powerful odours. The fresh or dried plants were exposed so that their odours were diffused in the air, or they were burnt in such a way that the smoke pervaded the atmosphere, a practice which was but recently maintained by the strewing of fragrant herbs in the dock on the first day of the opening of the Criminal Sessions at the Old Bailey. Occasionally, also, preparations of the plants were taken internally as medicines, whilst the dried herbs were frequently made up into "pomanders," or scent balls, to be carried about the person, or small scent-bottles were filled with the powdered herbs.

Antiseptic properties of plants

Arnauld de Villeneuve
Physician and Alchymist
Born about 1240. Died 1313

A fourteenth century "drynke for the pestilence" contained fever-few, mugwort, maythe (stinking mayweed), and other strong-smelling plants mixed with old ale. The writer of the book, in which the recipe appears, quaintly states that, "gif the seke drynke VI sponful at ones, it schal distroye the corupcion, and cauen the man or wumman, whethin it be." Ointments for cleansing and healing wounds contained vervain, resin, and mastic, whilst frankincense was mixed with wine as a lotion. A disinfecting powder for wounds, called "recheles," was a kind of incense; it was used for toothache, and as an ingredient in "a goud poudre for to slo the festour." Sage and salt, baked into cakes and powdered, formed a tooth powder. A sixteenth-century preventive of plague was a sponge dipped into vinegar and rose-water, or vinegar in which wormwood and rue had been boiled; the sponge was to be "smelled often." Later still, pomanders were made containing cinnamon, cloves, amber, nutmegs, storax, chamomile, juniper and red roses, beaten together to make a powder which was then made into a mass with rose-water. A preventive remedy for internal use, consisting of sage, honey and treacle was to be taken fasting, five or six spoonfuls daily. Rue, elder, red sage, white wine and ginger were the ingredients of another mixture, of which a good draught was to be taken every morning and evening, for the space of nine days. Finally, fumigations were resorted to in order to destroy the supposed "aura," or poison of the plague, for which purpose it was recommended that "such things ought to be used as exhale very subtile sulphurs, as the spicy drugs and gums." In the category referred to, were included storax, benzoin, frankincense and all aromatic roots, woods, etc., and it was asserted that "such drugs as are from a vegetable production and abound with subtile volatile parts, are of service to be exhaled into the air this way, both by their fitness to join with and cover those venomous *spicula that are on float*."

Pomanders and their use

Surgeon Attending to a Wound on a Patient's Leg

A celebrated ointment which enjoyed a great reputation in the Middle Ages as a dressing for all kinds of wounds was called "Egyptian ointment." It was composed of honey, 1 lb.; vinegar, ½ lb.; sulphate of copper, ½ oz.; and alum, ½ oz. The name of the originator of this formula is unknown, but as a dressing it undoubtedly possessed antiseptic properties, and must to some extent have justified its reputation. It is said to have proved to have been the most effective weapon against putrefaction, and as late as the eighteenth century, Bordenave, a French investigator and surgeon, states that he used it with success to restrict to a certain point putrefaction which threatened a whole limb.

"Egyptian ointment"

Braunschwig, a German surgeon (1497), was another who regarded gunpowder as a poison, and recommended, in order to neutralise its evil effects, that warm oil of violets should be poured into the wound. He also advocates camphor and oil of turpentine as local dressings, and recommends that wounds should be kept open by means of tents, rubbed with pork fat.

Braunschwig's method of treating wounds

Little progress was made in surgical treatment until the end of the fifteenth century. The surgeon of that period still relied on the red-hot cautery to arrest the flow of blood, and then dressed the wound with an ointment composed probably of dried earthworms in powder, Armenian bole, camphor and oil of roses. He might, indeed, have also inserted a drainage tube of reed or animal membrane, such as the windpipe of a rabbit.

The mortality from hæmorrhage on the battlefields and in operations at this period must have been terrible, for the boiling pitch, or oil, the red-hot iron, the styptic pellets, and other primitive methods of arresting blood were quite inadequate, and must at times even have accelerated death.

During the sixteenth century, the idea that air had some effect on wounds seems to have suggested itself to several surgeons. Fallopius states that he studied the action of air on wounds, and tried its effects.

In 1563, Felix Wuertz, a Swiss surgeon, advocated a new treatment for wounds, and to stop hæmorrhage he

Application of the Actual Cautery to a Wound

From a woodcut of the XVI century

Wuertz advises that wounds should be dressed quickly, and not exposed to the air

used crocus martis (oxide of iron), alum, and the white hair of the rabbit. He strongly opposed the use of the cautery as aggravating the pain, and deprecated the use of salves and dirty oils, in place of which he strongly recommended honey as the best local application. He also went so far as to say that "*the influence of air on wounds was dangerous, provoking irritation and cramp.*" He advised that

"*dressings should be made as quickly as possible, taking care to shut all doors and windows, to prevent the action of the air.*"

In a treatise on surgery written by Duchene towards the close of the sixteenth century there are some very original and remarkable statements with respect to the treatment of wounds. He says, "I think it worth mentioning, that many use, not only for the first dressing, but throughout the entire treatment of the wounds, simply tepid spring water, to which some add a little oil and vinegar. They wash the wound with it, and lay upon it wet lint or tow, and so successful is the result that people are astonished, and believe it is the result of a charm of magic words."

Duchene records some remarkable observations

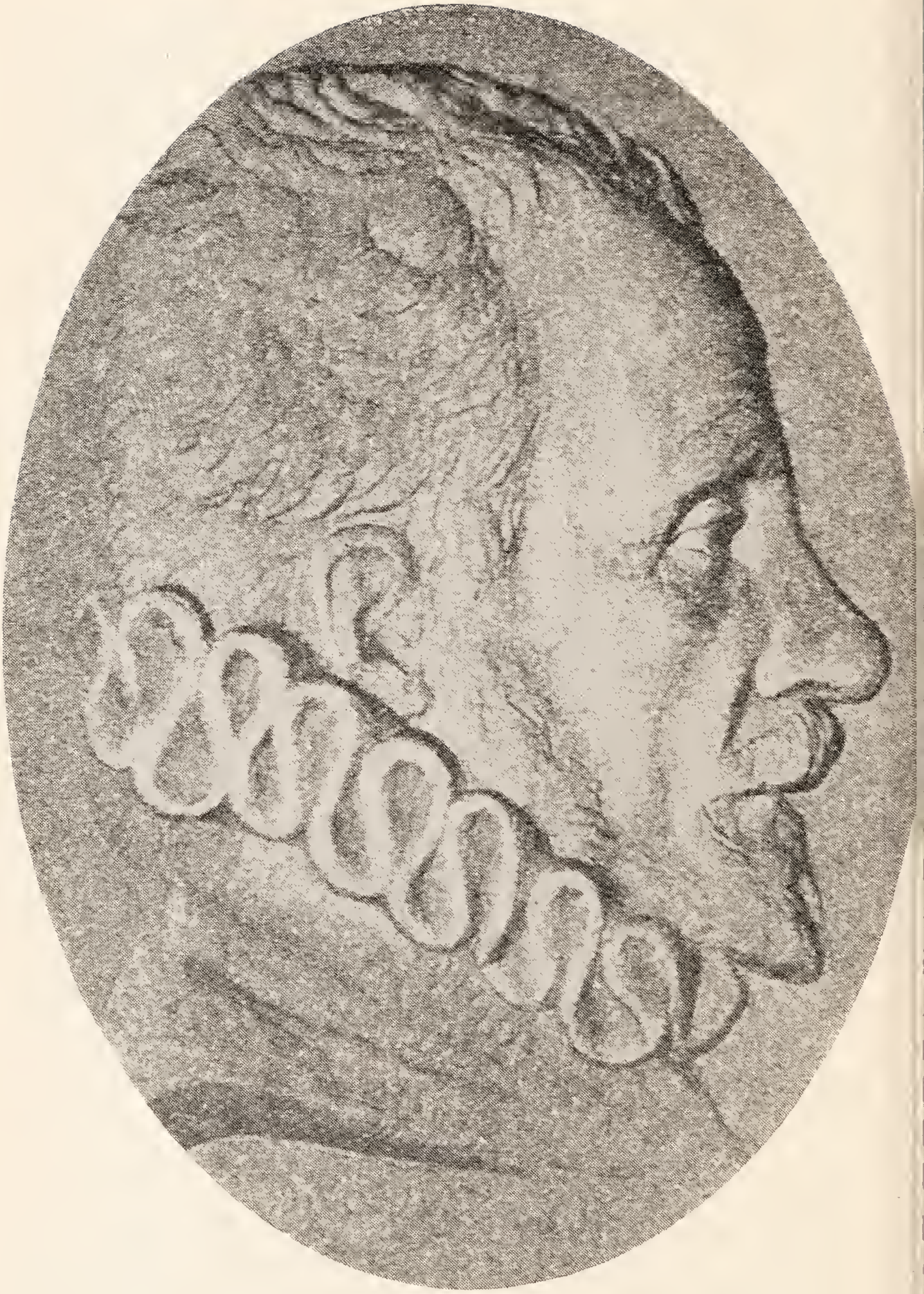
He advocated that a little oil and vinegar should be added to the water, "for," he states, "it is clear that vinegar resists corruption, for the reason that if something is put in it, it is conserved and will not putrefy. Oil acts in the same way, and if poured on wine or other liquor it prevents it turning sour *by preventing the air coming to it.*"

It must be readily acknowledged that these observations, which were made in 1576, practically outlined the principles which Lister brought into prominence three hundred years later.

John Vigo, the author of one of the most popular works on surgery in the sixteenth century, followed the antient custom of cauterising wounds with boiling oil.

Ambroise Paré, the father of French surgery, is said to have been the first to put a stop to the terrible treatment of arresting hæmorrhage with boiling oil. The story is told that once, after a certain battle, Paré found that, to his horror, no more boiling oil was available for the surgeons, and that he would be obliged to resort to some other method of treatment.

"At last," he states, "I was forced instead thereof to apply a mixture of the yolks of eggs, oil of roses and turpentine, a mixture which produced such excellent results that I resolved never more to burn thus cruelly



Ambroise Paré

Father of French Surgery

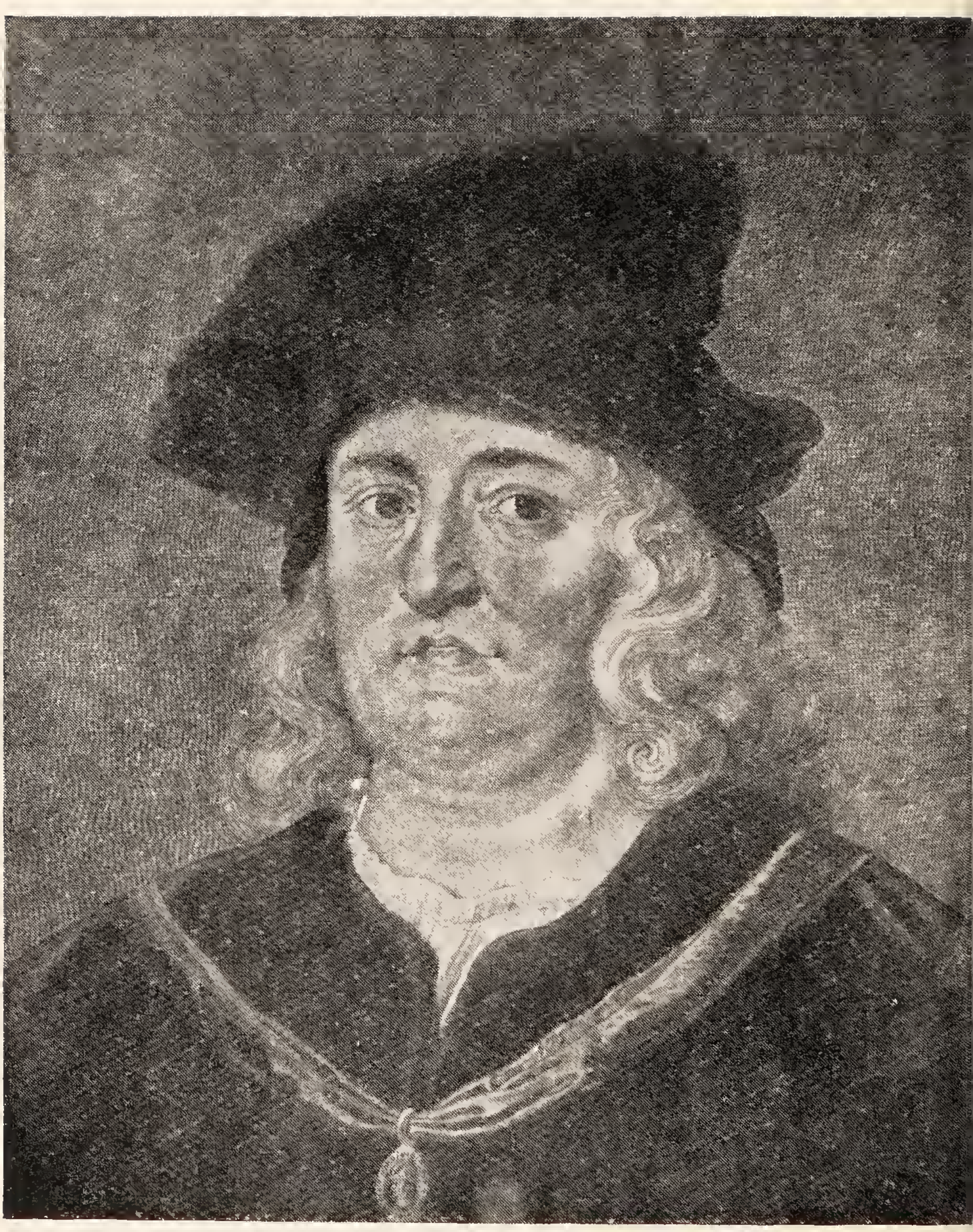
Born 1517. Died 1590

poor men with gunshot wounds." The usual dressing consisted of oil of elders mixed with treacle. Paré mentions how once he visited, at Turin, a surgeon who had invented a famous balm for dressing gunshot wounds. He states "he made me pay court to him for two years before I could possibly draw the recipe form him. In the end, thanks to my gifts and presents, he gave it to me, which was to boil in oil of lilies, young whelps just born, and earthworms, prepared with Venetian turpentine. Then I was joyful, and my heart made glad that I had understood his remedy, which was like that which I had obtained by chance." Paré experimented with other dressings, and in his works he advises the following treatment for a suppurating thigh: "The thigh and the whole of the leg must be fomented with a decoction of sage and rosemary, thyme, lavender, flowers of camomile and melilot, red roses boiled in white wine, with a drying powder made of oak ashes and a little vinegar and half a handful of salt." For a compound fracture he recommends white of egg, flour, soot from the chimney and fresh butter melted, to be applied to the wound.

Ambroise Paré abandons the use of boiling oil as a cautery

But Ambroise Paré initiated a still greater advance in surgical treatment by using the ligature in place of the actual or red-hot cautery in cases of amputation. He followed the French army during many long and arduous campaigns, and it was on the battlefield, at the Siege of Damvilliers, in 1552, that he first put his idea into practice. His teaching and practice concerning the ligature met with violent opposition, and it took a long time before it was universally recognised as the safest and most reliable treatment.

Paré did not invent the ligature, as is generally supposed, but merely re-discovered its use. Celsus speaks of it as an ordinary method in treating wounds, and Archigenes of Apamea (A.D. 48–117) tied vessels in amputating, after fixing a tight band at the root



PARACELSUS

THEOPHRASTUS BOMBASTUS VON HOHENHEIM

Physician and Alchymist. Born 1493. Died 1541

of the limb. During the latter part of the sixteenth century, hot wine fomentations seem to have been a favourite method of treating wounds, although Delacroix, another famous French surgeon, still advocated and used boiling pitch, oil and turpentine.

Early in the seventeenth century Paracelsus pointed out the abuse of the suture so much employed by surgeons of the day, and declared that "*Nature healed wounds by a curative balm if left to herself.*" He observed the benefit to a wound when the air had been excluded, and recommended the use of a solution of lead acetate in surgical treatment. But although many of the substances used at this time were antiseptics of a mild nature, unfortunately they had not sufficient germicidal power to render them effective.

Paracelsus observes that Nature left to herself is the best healer

Gersdorff, an Alsatian surgeon of great experience, who lived at this period, was a disciple of Paré's, and abandoned the use of the cautery and boiling oil. He employed a styptic of his own, which he kept secret, and, after amputating, was accustomed to cover the stump of the limb with a bull's bladder, and so protect it from the air.

Towards the close of his life, Sir Francis Bacon became interested in the subject of putrefaction, but his investigations were apparently cut short by his death, the primary cause for which, curiously enough, was induced by his enthusiasm on the subject. His biographer states, that towards the end of March in the year 1626, being near Highgate on a snowy day, he left his coach to collect snow, with which he meant to stuff a fowl, in order to observe the effect of cold in the preservation of its flesh. This interesting statement is all that is known of Bacon's experiments on the subject.

Sir Francis Bacon's experiments on preserving by cold

Surgeon Operating on a Patient's Arm

From a painting by Dusart of the XVII century

CHAPTER V

Antiseptic Methods in the Seventeenth and Eighteenth Centuries

During the sixteenth and seventeenth centuries, superstition and witchcraft played a prominent part in the treatment of wounds. Ointments, composed of human fat and the fat of various animals, were looked upon as potent healers. Kenelm Digby's method of treatment with his "Sympathetic Powder," or weapon salve, the virtues of which were so loudly extolled, had the merit of at least not interfering with Nature's own process of healing. Digby advocated that his salve should be applied to the weapon instead of to the wound, the latter being simply cleansed and wrapped in clean bandages.

Kenelm Digby's "Sympathetic Powder"

There was little actual advance at this period towards surgical antisepsis, but two very important discoveries were made which materially assisted those that were to come. About 1690, Leeuwenhoek, a Dutch physician, who had been making observations on the larvæ of frogs and other small animals, was able to see with his improved microscope organisms which hitherto were unknown, and to him may be ascribed the discovery of what were afterwards called microbes. Redi, a poet of Tuscany, about the same period, by some simple experiments, proved that the theory that maggots were spontaneously generated was erroneous. He showed that by protecting a piece of meat with fine wire gauze, so that flies were prevented from depositing their eggs upon it, maggots did not appear. Crude though this experiment was, Huxley considered it the foundation of modern bacteriological technique, and the wire gauze was the forerunner of the antiseptic gauze of modern surgery.

Redi makes an important discovery

In endeavouring to trace the steps that led to the discovery of what is now called antiseptic surgery, it should here be mentioned that the use of the word itself is of comparatively modern origin. The term which is now so generally

Origin of the word antiseptic

applied to substances used to prevent or arrest putrefaction or analogous fermentive changes, is derived from the Greek word "*anti*"—against, and "*septikos*"—causing putrefaction. The first known use of the word antiseptic occurs in a work on plague, by Place, in 1721, to whom we shall refer later. The paragraph in which the word occurs is as follows: "This phenomenon shows the motion of the pestilential poison to be putrefactive, it makes the use of *antisepticks* a reasonable way to oppose it."

First use of the word by Place in 1721

Until the beginning of the eighteenth century the methods adopted by surgeons in the treatment of wounds made little advance. Wine, walnut leaves, aloes, myrrh, alum, borax and nitre were the principal substances used as dressings up to this time, while boiling pitch and tar were the media employed by both naval and military surgeons to arrest hæmorrhage. The French surgeons were the first to inaugurate a new era in wound dressings, and early in the eighteenth century Delamotte strongly advocated the use of brandy as a dressing for wounds. He combined this treatment with the use of tincture of aloes, and in his work on surgery he describes how he successfully dressed wounds with a pledget dipped in tincture of aloes, with the addition of wool soaked in brandy. Two bandages saturated in wine were to be finally applied over the wound as a compress.

A new method of treating wounds adopted by French surgeons

In 1720 the harmful effect of air on wounds was again recognised by Belloste, a French Army surgeon, who wrote as follows: "Both the Ancients and Moderns agree on the bad influence of air on wounds, and it is in the vitiated air of the Army hospitals that we must prevent it with all our power from penetrating the internal parts of our bodies, and those which are deprived of their integuments, for fear it will communicate to them its harmful effects." "*Air is a terrible ravager of wounds*," he adds, and concludes with the significant statement

Belloste records the bad influence of air on wounds

that "the promptest methods of dressing ought to be preferred to all others." Belloste followed the example of Delamotte in using brandy as a dressing, especially in wounds on the head. Referring to a wound on the cheek, he states that he employed with success balsam of Peru, but in other cases found brandy, alcohol and wine to be the most effective form of treatment for wounds.

Brandy as a dressing

De Villars, another French Army surgeon of this period, writing on the general cure of wounds, says: "What makes air so harmful and causes the liquids in the body to corrupt, is when it is impregnated with bad exhalations. *Wounds ought then to be dressed as quickly as possible.* He recommended tutty powder, white lead, burnt lead and burnt alum as useful dressings, but for simple wounds he states it is sufficient to wash them with pure, luke-warm water, or water mixed with red wine, and to apply a poultice soaked in brandy. If the wound be deep it ought to be washed and dried with a soft piece of lint, dipped in lukewarm red wine, then a bandage applied soaked in brandy, or a pledget impregnated with some kind of balsamic dressing.

De Villars on the general cure of wounds

Some attempt at the drainage of wounds was made by Percival Pott, Benjamin Bell, and other famous surgeons of this period, and a glimmer of light on the causation of internal disease began to be manifested.

In a treatise on the Plague, written by Place in 1721, he makes the following remarkable statements, a portion of which we have previously quoted: "As this phenomenon shows the motion of the pestilential poison to be putrefactive, it makes the use of antisepticks a reasonable way to oppose it, and whatever resists and is preservative against putrefaction, admits not of the generation of insects. If this hypothesis is proceeded upon, our proper and promising materials to yield medicine and for physical preparations against it, such as cedar, Irish oak, cinnamon,

Place's treatise on plague

spices, and what was used by the ancients in their embalmments of dead bodies; *for the same virtues that preserved dead bodies from insects and putrefaction I know no reason why they should not preserve the same bodies living from the same thing.*" But, unfortunately, Place did not put his theories into practice, although he appears to have clearly recognised the principles upon which antiseptic surgery is founded.

Place's remarkable theories on putrefaction

About the same period, Goiffon, a medical practitioner of Lyons, also made some interesting observations on the cause of the plague, which was at that time decimating Marseilles. He propounded the theory that the disease was caused *by a poison which came from without, and suggested that this poison may be propagated by little worms or insects.* He further suggested that "poisonous insects brought from foreign merchandise into the country and escaping into the air of the town, would produce all the fatal effects observed in plague." In discussing the treatment, he says that a contra-poison, or anti-toxin, should be sought. Goiffon's theory certainly foreshadows in a remarkable manner the doctrines to which Pasteur gave utterance 150 years later.

Goiffon's theory of the origin of plague

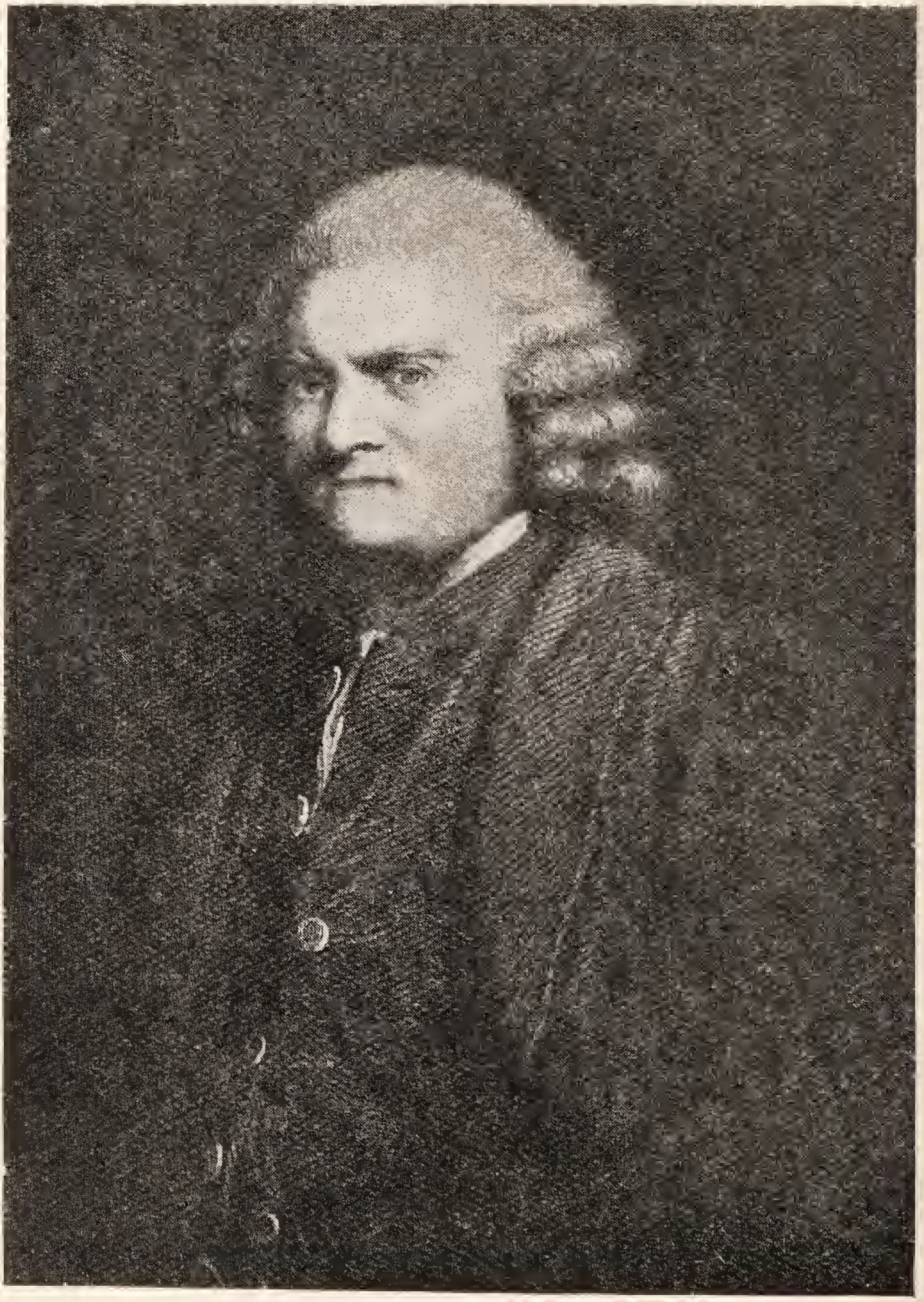
About the middle of the century, the problem of putrefaction, its cause and effects, appears again to have attracted the attention of scientific observers. Among the most prominent of these, and one to whom we must allot a foremost place amongst the pioneers in the investigation of antiseptic agents, was Sir John Pringle. Born in Scotland, in 1707, the son of a Scottish baronet, on leaving school he became a student of medicine at Edinburgh University. From thence he went to Leyden, working under the famous Boerhaave, and eventually graduated there in 1730. Returning to his native country, he commenced practice in Edinburgh, and a few years later became Professor of Pneumatics at the University. In 1742, he was appointed physician to the Earl of Stair, who was then

Commander of the British Army, and, shortly afterwards, was constituted physician to the Military Hospital in Flanders, and during the time he held that office, served throughout the campaign in the Low Countries as physician to the British troops. During this period he made a careful study of the diseases prevalent in the army, the results of which he published in the form of a treatise, which created at the time a revolution in military medicine and surgery throughout Europe. This work passed through seven editions, and was translated into French and German. Pringle was the first to propose that hospitals on both sides should be treated as sanctuaries for the sick, and mutually protected. He did much for the improvement of military hospitals by the introduction of ventilation into the wards for the wounded.

The career of Sir John Pringle, a pioneer in the study of antiseptics

On retiring from his military post he returned to Great Britain, and in 1750 commenced his investigations of antiseptics, the results of which he communicated in several papers to the Royal Society. These were entitled "Experiments upon aseptic and antiseptic substances, with remarks relating to their use in the theory of medicine." In the course of this treatise, he states, he was led to make his experiments on putrefaction, by having a large number of putrid distempers under his care in the hospitals of the army. Before his time it had been a common belief that alkaline salts promoted putrefaction, but Pringle by his experiments completely controverted this theory by proving that alkali tended to arrest rather than to promote putrefaction; to use his own words: "By some mistake of the chemist's, putrefaction in animal substances was confounded with the idea of a highly alkaline salt." To prove this he at first carried out a series of experiments with alkaline salts as preservatives of beef, to demonstrate their power of resisting putrefactive changes. He then carried out a similar series of experiments with resins and gums,

Pringle's experiments



Sir John Pringle

Famous Army Surgeon

Born 1707. Died 1782

including myrrh, which he states he found twelve times more antiseptic than sea-water and camphor. The results of his investigations he embodied in a table, which is here produced, which claims to show the comparative powers of various solids :—

Sea salt . .	1	Salini mixture (salt of wormwood and lemon juice)	3
Sal gemmæ . .	1+	Nitre . . .	4+
Tartar vitriolated	2	Salt of hartshorn .	4+
Spiritus Mindereri (vinegar and salt of hartshorn) .	2	,, ,, wormwood	4+
Tartarus Solubilis	2	Borax . . .	12+
Sal Diureticus .	2+	Salt of amber .	20+
Crude Sal Ammoniacum . .	3	Alum . . .	30+

For these researches Sir John Pringle was awarded the Copley gold medal, and in 1761 was appointed by George III. to be physician to the Queen's household. He died in 1782.

About the middle of the eighteenth century a "grande dame" of France became so much attracted by the study of putrefaction and its causes, that at the age of twenty-three she left the fashionable world which she had hitherto adorned, installed herself in a laboratory, and began a series of experiments which had a real practical aim. This unusual occurrence is the more worthy of note, inasmuch as the lady never signed her works. Those who know the work entitled: "Essai pour servir à l'histoire de la Putrefaction," a volume of 600 pages, published in 1766 by Didot the younger, are, in all probability, unaware of the fact that the author was Madame d'Arconville. Her history is remarkable. Marie Genevieve Charlotte Darlus, was the daughter of André Guillaume Darlus, secretary to the King, and farmer-general, and of Françoise Gaudicher de la Hallebardière. She was born October 17, 1720. On February 28, 1735, at the age of fourteen, she was married to Louis Lazare Thiroux d'Arconville, by

A lady scientist of the eighteenth century

whom she had three children. At the age of twenty-three she was attacked by smallpox, which was very prevalent at that time, and terribly disfigured; inasmuch that she renounced the world, dressed herself "as an old woman in a cap and wings," and gave herself up henceforward to the study of science and letters. She studied history, medicine, physics, chemistry, and even followed the anatomical and botanical courses at the Jardin du Roi, thus acquiring knowledge equally varied and extensive. Her salon was attended by the most distinguished men of the period—Turgot, Malesherbes, Monttiyen, de Tussieu, Fourcroy, Lavoisier, and Gresset were all to be met there. She made several translations from the English, and herself published anonymously several books which attained a certain reputation.

Study of science and letters

During the Terror she was imprisoned at Picpus, together with her eldest son, Thiroux de Crosne, ex-lieutenant-general of police, and her brother-in-law, Angrand d'Alleray, both of whom died on the scaffold. More fortunate than they, she regained her liberty on the 9th Thermidor. She died in Paris at her hotel, No. 15, Rue de Chaume (now No. 60, Rue des Archives), on December 24, 1805, at the age of 85, and was buried in the parish church of St. Nervy.

Her works were truly encyclopædic, embracing history, literature, physics, philosophy, and chemistry, but we are only concerned with the "Essai pour servir à l'histoire de la Putrefaction."

Pringle had previously published his researches on the subject, and it was Madame d'Arconville's aim to complete his work, which evidently inspired her. She understood the practical use to which such investigations might tend. "The studies of every sensible man should have a practical aim," she wrote in her preface. "The knowledge of the substances which may delay or hasten putrefaction," was the practical aim which she set before herself. It is interesting to note that she gives the name of anti-septics to those substances which retard putrefaction,

or septics to those which promote it. By a course of reasoning she foresaw the possibility of their use in medicine, particularly in the treatment of wounds, and gives an accurate classification of antiseptics. All her experiments, to the number of 300, were conducted on similar lines. She placed in a phial a certain determined weight of the particular putrefiable substance which she wished to investigate, such as meat, milk, eggs, bile, and added thereto a certain determined quantity (always the same) of the liquid whose antiseptic properties she wished to test. She was careful to note exactly the temperature, state of the weather, directions of storms, etc.; moreover, by the aid of blue paper or of syrup of violets, she tested the acidity or the alkalinity of her medium. Thus she was able to compute the delay in putrefaction caused by the action of the antiseptic.

These experiments lasted ten years (1754–1764), and we shall see presently what her theories were with regard to matter. She begins by saying that certain substances favour putrefaction; these she calls septics. Evidently she is speaking of substances which ferment readily, such as sugar, gum arabic, certain salts and infusions. Next, she divides the substances examined into thirty-two classes, according to the length of time during which they have kept meat sweet from one day to seven months. The last class of antiseptics comprises those which, she states, preserve it indefinitely. She recorded her results in the following table:—

Madame d'Arconville's experiments

Metallic salts.—Corrosive sublimate, blue vitriol, subsulphate of mercury, silver vitriol, sal de Saturne, nitre mercurial.

Gums and resins.—Balsam of Peru, camphor, Burgundy pitch, styrax, ammoniac.

Extracts and simple substances.—Extract of cinchona, powdered cinchona, dried guaicum, powdered gall-nuts.

Vinous liquids.—Bordeaux, Arbois, and Spanish wines.

Acids.—Red vinegar.
Fixed alkalis.—Volatile salts of hartshorn.
Earths.—Quicklime.
Juices.—Neutral salts, earthy salts.
Waters.—None.

These substances, she says, not merely arrest putrefaction in decomposing bodies, but also take away the corruption which depends upon it. She calls these true antiseptics; nor can we contradict her, seeing that her list contains such substances as corrosive sublimate, sulphate of copper, balsam of Peru, etc. "It is true," she writes, "that the metallic salts with which I have made my experiments can for the most part be employed in medicine only with much care and precaution, and they must even be diluted and softened if they are to be used to preserve anatomical subjects, such as birds and insects. But there is every reason to believe that by diluting these substances with water we can diminish their stipticite, without diminishing their preservative, qualities. By this method, though we can rarely use them for the treatment of wounds and diseases, we can at least make them of service in preserving anatomical subjects from corruption. . . . But without dwelling longer on this point, the class preceding, furnishes us with plenty of other antiseptic substances, which we can employ successfully, both in medicine and surgery, without having recourse to the metallic salts." These substances are powdered cinchona, styrax, benzoin, camphor, balsam of Peru, etc. Madame d'Arconville arrived, moreover, at another practical conclusion, to which she refers repeatedly in the course of her work: *i. e.* that to prevent putrefaction, it is, above all things, necessary to exclude the outer air. This is her theory upon the subject. "Putrefaction is a natural process. Every organic body, as soon as it ceases to mature, advances more or less rapidly towards destruction. We may regard putrefaction as the design of Nature, and the two degrees of fermentation which precede it as its preliminaries."

Her theories on the cause of putrefaction

In her opinion it is a simple problem of disintegration. The two degrees of fermentation to which she refers, are acid fermentation and gaseous fermentation, stages through which all putrefying bodies must pass.

Madame d'Arconville undoubtedly deserves a place among the pioneers of the study of antiseptics.

In 1745, Needham made a series of experiments in order to show that the higher forms of animal life, which had been supposed to arise from putrefying matter, came from outside sources. He heated putrescible materials in vessels whereto the re-entry of atmospheric air was as rigidly as possible prevented; if there had been pre-existent germs, he urged, these must have been destroyed by the high temperature; animalculæ were discovered, therefore these must have been generated from the organic material. The result of his experiments was afterwards systematised by Buffon. The low forms of life were hitherto supposed to arise from the dead elements of matter. Needham's experiments were followed by Spallanzani, who argued that in the former's experiments, the temperature used was not sufficiently high to destroy the vital properties of the germs, and that to suppress all production of infusoria, it was necessary to maintain a boiling temperature for three-quarters of an hour.

Needham's experiments

Sweet-smelling plants, such as woodruffe, were recommended for medicinal purposes by Linnæus, in his *Philosophia Botanica*, in 1751, where it is stated that such plants not only drive away moths and other destructive vermin, but also "when chewed, preserve people from infectious disorders." In recent years, Klein has pointed out that some plants, owing to their strong odours, have a certain amount of antiseptic power. The experiments of Omeltschenko have confirmed the view that the vapours of essential oils also exercise a bactericidal action. The bacillus of typhus has been killed in 45 minutes by air containing the vapour from oil of cinnamon or oil of valerian. Similarly, the bacillus of tuberculosis was destroyed

David MacBride, M.D.

Born 1726. Died 1778

in 23 hours by oil of cinnamon, and in 12 hours by oil of lavender or oil of eucalyptus. Essential oils have been classified by Omeltschenko, according to their bactericidal power, as follows:—Cinnamon, fennel, lavender, cloves, thyme, mint, anise, eucalyptus, turpentine, lemon and rose, the last two being very weak as compared with the others. The work done in this direction requires confirmation, but the results so far obtained, go far to prove that there was something in the notions which prevailed long ago with regard to the preventive and remedial powers of odorous plants and their products.

Pibrac advocates a simple method of dressing wounds

In 1753, Pibrac introduced a simple method of dressing wounds, after an operation, which he describes as follows: "The sides of the wound should be brought together with bandages, and I put others of finer quality on the wound, dipped in a mixture of plain water and brandy, in which I had beaten up the whites of eggs." Heister, writing in 1763, stated his convictions that wounds were badly affected by the action of the air, and recommended that dressings should be applied as rapidly as possible. In 1767, Professor MacBride, of Dublin, carried out some experiments on the respective qualities of antiseptics. In the report of his investigations, he states that, "acids and alkalis destroy putrefaction, and give back the original softness to affected parts, but not in live bodies." He made a series of interesting experiments to test the antiseptic power of substances used by physicians in antient times for preventing putrefaction. His method was to place a certain quantity of these substances with fresh meat, and to note the period at which putrefaction set in. The results of these experiments, he says, proved that vitriol, sea salt, vinegar, and lemon juice would keep meat sweet for four days. He also tried the effects of several kinds of alcoholic liquors in the same manner, and claimed that claret and Portuguese white wine possessed the greatest antiseptic properties. Crude

MacBride's researches

as these experiments were, they served to attract attention, and led others to search for substances of greater power to prevent decay.

The Academy of Sciences at Dijon, in 1770, offered a prize for the best treatise on Antiseptics. This was won by Bordenave, a French investigator. His conclusions are summed up in an essay, in which he states that "those who occupy themselves in the search for antiseptic remedies, found their ideas on the effects they observed in testing the flesh of animals with various substances. These experiments, however, though throwing some light on the subject, are illusory in some respects, and quite insufficient. The flesh on which they experimented was that of healthy animals who died suddenly, and in which there was no evidence of putrefaction, a state which can hardly be compared with that of affected parts. The same treatment cannot be applied in arresting or diminishing putrefaction on a living body. The most efficacious antiseptics would be employed in vain, and their use would be superfluous, often prejudicial, were not the nature and the causes of the disease taken into consideration.

Bordenave's investigations into the cause of putrefaction

"The cause of putrefaction in a living body being the separation of too great a quantity of air, the chief use of an antiseptic ought to be to prevent that element escaping, or to give back to the body, actually in a state of putrefaction, a part of the air which it has lost.

"Such are the effects which have been shown by experiments to take place with different substances in bodies quickened by the use of different remedies. Thus, in antiseptics, it is not only necessary to consider the remedies which arrest actual putrefaction, but those which prevent and cure it, although in appearance these remedies may be very similar.

"It has been recorded in Germany that a coating of turpentine oil preserved a gangrened leg for five months, which became as dry as that of a mummy."

Bordenave strongly advocated the use of astringent substances as preventives of putrefaction, and states that he employed the same method for preventing humid putrefaction in the foot of an old man afflicted with scurvy, while waiting for nature to trace the separation line which occurs in the joint of the foot and leg.

"Experiments have shown us," he continues, "that putrid animal exhalations are very pernicious. A great many pestilential diseases have been brought about by large quantities of locusts and dead whales. After a battle, buried corpses have often given rise to epidemics. Ambroise Paré records that a great number of dead having been thrown, in 1562, into a deep well, there arose, two months after, contagious and offensive fumes, which spread in the country and round about, and many districts were infected with plague. What is said of putrefied bodies can also be applied to noxious mineral or vegetable matter, and it is easily understood how air which has thus become changed, can become in us a cause of putrefaction, by causing a putrid fermentation which infects all the liquids in our bodies."

Following on the simple lines suggested by Pibrac, in 1780, Hevin, writing on the treatment of wounds, states: "For ordinary wounds it is only necessary to foment the parts from time to time with lukewarm water, vulnerary water, or brandy distilled with two-thirds of ordinary water. Also, that sometimes nature alone is sufficient to heal wounds, provided they are covered up with dry lint, to protect the flesh from contact with the air."

About 1785, Larrey, who was Surgeon-in-Chief to Napoleon's "Grande Armée," and Percy, another famous military surgeon under the Consulate and Empire, both strongly advocated the use of pure cold water in the treatment of gunshot wounds. According to Rochard, "they eventually employed no other dressing but pure water, with the addition sometimes of alcohol or extract of lead."

Larrey and Percy use cold water in dressing wounds

A story is told that after a battle near Strasburg in 1785, the two surgeons were called to see some wounded soldiers, whose wounds were claimed to have been quickly healed after being dressed by an Alsatian miller with some miraculous water. On investigating the so-called miraculous water, Percy and Larrey found that it was nothing but water from the millstream in which the old miller had dissolved a little alum; the application of the dressing being accompanied by some incantations and cabalistic signs. The surgeons resolved to experiment on their own account with so simple a remedy, and the results astonished them. Percy soon became imbued with such faith in the therapeutic value of the pure-water dressing, that he is said to have once remarked that he would have abandoned army surgery if he had not been able to use it.

Extolled by Larrey and himself, the pure-water surgical treatment of wounds soon became known throughout Europe, and the practice was adopted by most army surgeons. Alcohol and vulnerary herbs were practically abandoned, although alum, salt, brandy, and extract of lead were still added to water or applied otherwise, when good water was not obtainable.

Percy's new method of dressing was completed by enveloping the wound with an impermeable piece of linen to prevent evaporation.

Although many investigators came so near the mark, they never seemed to grasp the importance of applying the principles they had discovered to practical utility, and though a considerable advance was made in the study of antiseptics during the eighteenth century, cauterisation with red-hot irons survived until its close, and was even warmly advocated by Pouteau, the leader of the Lyons School of Surgery.

CHAPTER VI

Antiseptic Surgery:
The Period of Pasteur and Lister

The advent of the nineteenth century saw the dawn of a new era, which was destined to revolutionise the surgical art. The investigation of the cause of putrefaction excited interest even beyond the world of science, and to Appert, a French confectioner, we owe the first contribution to the growing knowledge of the principles underlying antiseptics in the nineteenth century. He discovered a method of preserving meat, fruit and vegetables by means of excluding the air and hermetically sealing the vessel in which they were contained.

Appert's great discovery

In 1822, Treviranus established the fact that the various kinds of animalculæ observed, varied with, and depended upon, in the case of decomposing vegetable macerations, the kinds of plants employed. Gay-Lussac made an examination of the air contained in bottles in which decomposing substances had bcen preserved by Appert's method, and finding that it contained no oxygen, concluded that the presence of oxygen was the chief cause of putrefaction. This view, however, was soon exploded by Schwann in 1837, who made a series of important experiments on putrefaction. He placed decoctions of meat in flasks, sterilised the decoctions by boiling, and then supplied them with calcined air, the power of which to support life he showed to be unimpaired. Under these circumstances, putrefaction never set in. Hence he concluded that putrefaction was not due to the contact of air alone, as affirmed by Gay-Lussac, but to something suspended in the air, which heat was able to destroy, and thus exploded the latter's theory.

Schwann controverts Gay-Lussac's theory

In 1835, Bassi undertook an investigation of the disease in silkworms, which was known as muscadine. He found and proved that it was caused by a parasite, and discovered that the parasite could be

Louis Pasteur

Born 1822. Died 1895

killed by certain substances. He was a man of keen penetration, and foresaw that this discovery meant something more than the elucidation of the cause of the silkworm disease. He stated his belief that smallpox, plague, and other contagious diseases were produced by vegetable or animal parasites, and that gangrene was caused by such entities. In his own words, "observation and experiment demonstrate to us, that all contagions disappear or cease to act in the individual whom they assail, when agents or means are used capable of destroying the life of the animal or vegetable organism of the lowest class that produces, so to speak, contagious diseases."

Bassi investigates the disease of silk-worms, and recognises a parasite

Bassi actually cured certain ulcerations by injections of corrosive sublimate, which is now so largely used in antiseptic surgery.

Schwann's discovery was corroborated, in 1854, by Schrœder, and, in 1859, by Busch, when the air supplied to the flask was neither heated nor chemically acted upon, but simply allowed to pass through a plug of cotton wool which acted as a filter.

The investigation made by Pouchet, who, with great care, examined the progressive development of living forms in putrefying solutions, must also be mentioned. He concluded that organisms could be found in organic solutions which had been boiled, and for which no germs could have possible access as, instead of atmospheric air, an artificial atmosphere or oxygen alone was admitted to the flask. These conclusions were strongly contested at the French Academy of Sciences, by Milne Edwards, Claude Bernard, and others.

Pouchet advances a new theory

It was 1845 before the next step in advance was made in the germ theory of disease, when Semmelweiss, an Austrian physician, discovered that puerperal fever, the rate of mortality from which was terribly high in the General Hospital at Vienna, was due to infection borne from the dissecting-room on the hands of the students, He insisted that before proceeding to

examine any patient, the student should thoroughly cleanse his hands with chlorine or chlorinated lime-water. The result of these precautions reduced the death-rate from 12·24 per cent. to 1·27 per cent. But in spite of such extraordinary results, and the vigorous manner in which Semmelweiss advocated his doctrines, the principles he laid down were neglected and bore no fruit.

New methods advocated by Semmelweiss

The commencement of a new epoch came as a direct outgrowth of Pasteur's studies of the fermentation of alcoholic beverages. Probably, no one thought at the time that the result of these researches would be so far-reaching and prove of such inestimable benefit to humanity. Pasteur discovered not only that the fermentation of beer and wine was due to living organisms, but that many other fermentations, and indeed all putrefactions, were due to the same cause. The remarkable series of experiments which he entered upon to prove his theories must be regarded as one of the most brilliant discoveries ever made in the realms of science. These he conducted with a double object in view, the first being the refutation of the doctrine of abiogenesis, or spontaneous generation, and second, the establishment of the fact that all fermentation is due to the presence of minute organisms or living germs, and, without these, the life needful for the process of fermentation could not exist. He showed that rancid butter owed its butyric fermentation to the presence of similar putrefactive infusoria, and that the presence of air was destructive to these—in short, that they throve without oxygen. Pasteur divided microscopic organisms into the two great classes, which he named aerobies and anaerobies respectively. "There is nothing in the air," he affirmed, "that is conditional to life save the germ it carries," and this theory he set out to prove. Pouchet and his followers at once took up the gauntlet thrown down by Pasteur, and a long scientific duel between these two leaders and their disciples followed.

Pasteur commences his researches on fermentation

The issue was one of the greatest importance, and Pasteur renewed his researches so that he might prove his case up to the hilt. He asserted that if absolutely pure air could be obtained from all sources, no change would occur in the putrescible fluid, and, to prove this, he undertook some experiments at Chamonix on September 20, 1860. To the summit of Montamvert he took twenty flasks, which were filled with the pure air and immediately hermetically sealed. Of these only one was found to be contaminated, from which he adduced that dust suspended in the atmospheric air is the exclusive origin and the necessary condition of life infusions. He further demonstrated that decomposition of substances and fluids was only another form of fermentation, and that animal fluids, such as blood, did not putrefy, if pure and kept from the air, the vibrios of putrefaction being excluded. In 1862, Tyndall confirmed Pasteur's conclusions and demonstrated the truth of his inferences by experiments which covered a number of years. Writing to Pasteur at a later period, he says: "For the first time in the history of science we are justified in cherishing confidently the hope that, so far as epidemic diseases are concerned, medicine will soon be delivered from empiricism and placed on a real scientific basis. When that great day shall come, humanity will, in my opinion, recognise the fact that the greatest part of its gratitude will be due to you."

Pasteur confirms his theories

Tyndall confirms Pasteur's conclusion

Pasteur's later experiments led him to the conclusion that suppuration was but a fermentation of the flesh, and that this might be prevented by destroying the germs that caused it, or by preventing their entrance. To this end, in 1862, he urged the use of boric acid for surgical purposes, as in the disinfection of the blood.

It was on April 30, 1878, that Pasteur gave his famous lecture, in which he propounded the germ theory in his own name, and that of Joubert and Chamberlane. He began in the following notable words: "All science is gained by mutual support.

Pasteur's Tomb

Paris

When, subsequently to my early communications on fermentation in 1857-58, it was admitted that ferments properly so-called are living beings; that germs of microscopical organisms abound on the surface of all objects in the atmosphere and in water; that the hypothesis of spontaneous generation is a chimera; that wine, beer, vinegar, blood, and all the liquids of the economy are preserved from their common changes, when in contact with pure air—Medicine and Surgery cast their eyes towards these new lights." He then proceeded to expound, in his masterly manner, the theories that he had elaborated. "If I had the honour of being a surgeon," he continued, "convinced as I am of the dangers caused by the germs of microbes scattered on the surface of every object, particularly in the hospitals, not only would I use absolutely clean instruments, but after cleansing my hands with the greatest care and putting them through a flame (an easy thing to do with a little practice), I would only make use of charpie, bandages and sponges which had previously been raised to a heat of from 130° C. to 150° C., and I would only employ water which had been heated from 110° C. to 120° C."

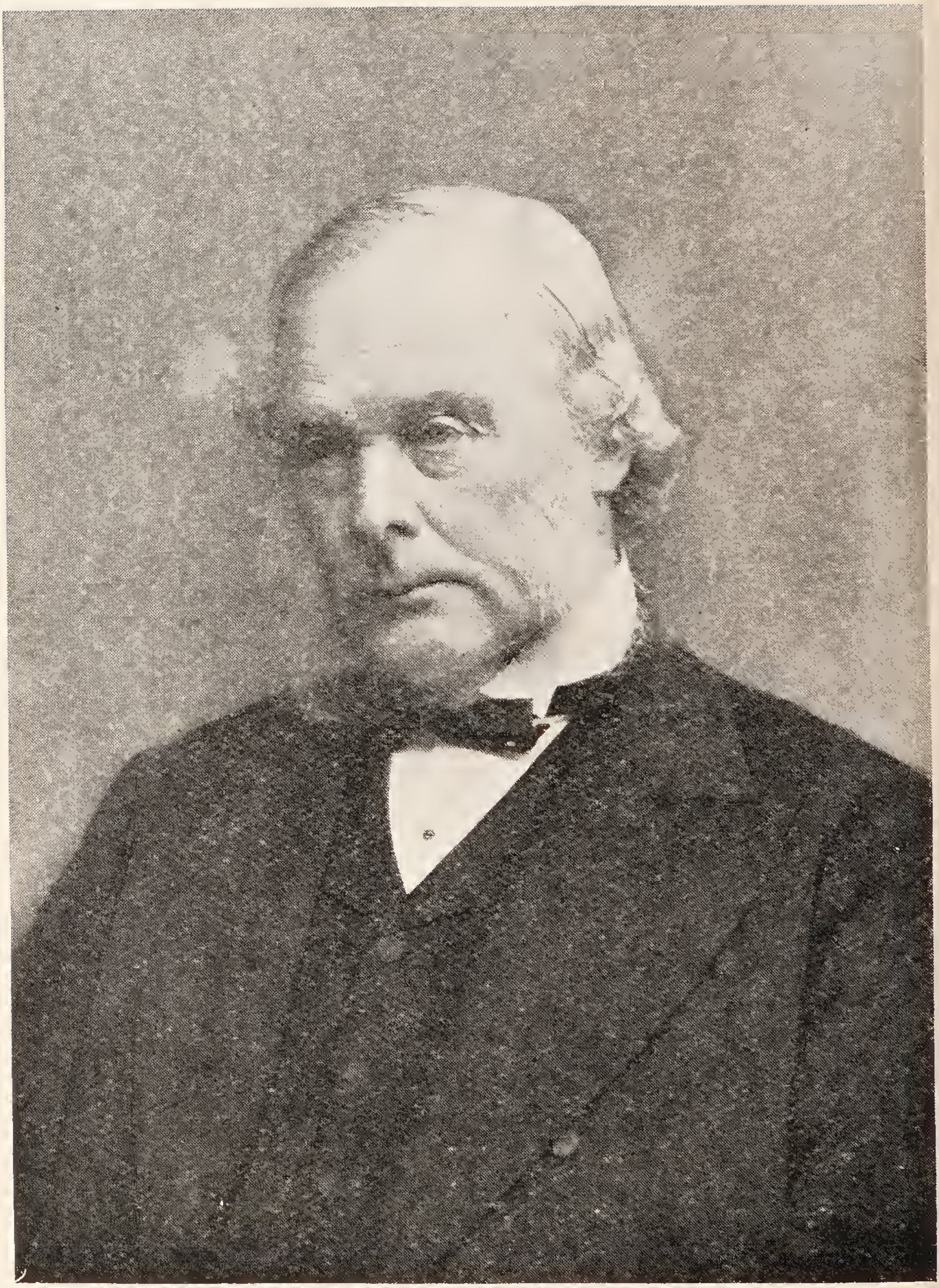
First use of the term microbe

It was Sédillot, in March, 1878, who first proposed the word microbe to be used as a generic term for the class of organism described by Pasteur. Through Pasteur's adoption of it, the word soon became used all over the world.

Pasteur's later researches into the causation of splenic fever and hydrophobia, and the attenuation of virus, are too well known to be recapitulated here.

Detz, Schrœder and Hewson revive the use of absorbent earth in dressing wounds

Meanwhile, surgeons were still groping in the dark for some dressing that would prevent the terrible mortalities that resulted in many cases from open wounds. In 1858, Detz revived the antient practice of using an absorbent earth as a surgical dressing. He was followed by Schrœder, who advocated a similar method in 1863, and still later by Hewson, in the United States, in 1872, whose method was as follows: Yellow clay, dried



Lord Lister

Born 1827

and powdered, was sifted in fine muslin and applied to the wound. This was claimed to relieve pain, diminish suppuration, and promote the process of healing. In 1865, Werner de Mulhouse suggested a dressing composed of Venice turpentine, 1000, sodium bi-carbonate, 25, dissolved in distilled water, 10 litres. A little later, the use of turpentine was revived as a dressing for wounds by Dr. Bond, who claimed that it possessed "incontestably the property of neutralising putrid odours," and applied on the surface of a wound, it adhered closely, spreading a thin skin around it, and thus sheltering it from the air, an effect which is lasting, on account of the slowness with which it evaporates.

On the other hand, turpentine can be applied to a raw wound without harm, and it exercises on the healing process a marked and stimulating effect.

In 1854, the first attempts to use carbolic acid as a surgical dressing were made by Lemaire, of Paris; and in 1855 it was first employed at St. Mary's Hospital in London.

Carbolic acid first used as a surgical dressing

Although Pasteur himself had seen the bearing that these discoveries were likely to have on the surgical art, it was left to Lister to carry out and apply them to their great life-saving conclusion.

Lister's early life

Joseph Lister was born on April 5, 1827, at Upton in Essex. His father was a merchant in the City of London, and he received his early education at a school kept by members of the Society of Friends at Tottenham. He subsequently proceeded to University College, and took his B.A. degree at the early age of twenty. He then spent five years in the study of medicine at the medical faculty of University College and at University College Hospital, graduating in medicine in 1852. After serving the usual offices in hospital he determined to visit Edinburgh to obtain experience under Syme, to whom he became assistant.

In 1860 he was appointed Professor of Surgery to Glasgow University, but before leaving for that city

Appointed Professor of Surgery to Glasgow University

he had already commenced his bacteriological work in connection with antiseptics. In 1865, he communicated to the *Lancet* a series of papers in which he laid down, as the basis of his methods, the principles established by the philosophical researches of Pasteur.

Syme's methods

Before Lister's time, the method devised by Syme of Edinburgh was that generally adopted in the treatment of wounds. Hæmorrhage, in the case of small vessels, was arrested by torsion. The stitches were of silver wire, as recommended by Marion Sims in 1857. Pressure was made on the flaps or sides of the wound by folded pads of dry lint, and a piece of the same material was bandaged lightly over its lips. When a complaint of pain and a quickened pulse gave the warning of commencing suppuration, the dressings were removed by being bathed with warm water, and either a water dressing covered with gutta percha tissue or a poultice was applied. Complete union could not be looked for under any circumstances until the last of the ligatures had separated, which might be three weeks, or even longer, after the infliction of the wound.

At the period of Lister's appointment to Glasgow, tetanus, erysipelas, septicæmia, pyæmia, and hospital gangrene were scarcely ever absent from the wards of our hospitals. There was no certain knowledge of the causation of these wound-begotten diseases, and no sure means of avoiding them.

Many a surgeon's heart was well nigh broken by these terrible visitants after he had done everything in his power to bring about his patient's recovery.

Lister's work in Glasgow

Such was the condition of things in Glasgow when Lister took up his work there. Hospital diseases were distressingly prevalent, and the fate of every patient who suffered from a wound had to be regarded with some degree of anxiety. These conditions produced in Lister's mind a sense of discontent with things as they were, although others appeared to regard them as inevitable.

He began by insisting on scrupulous cleanliness in the wards, on the frequent washing of the hands of all those assisting at operations or engaged in the dressing of wounds, while he constantly used various deodorant lotions and recommended the frequent changing of dressings in all suppurating wounds.

In an address that he gave at the meeting of the British Medical Association in Dublin, in 1867, he observed "that when it had been shown by the researches of Pasteur that the septic properties of the atmosphere depended not on oxygen or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that the decomposition of the injured part might be avoided, without excluding the air, by applying as a dressing some material capable of destroying the life of the floating particles." The material he was first led to use was carbolic acid, and he determined to try what power it might possess in preventing putrefactive changes in a case of compound fracture. At that time compound fractures were the dread of surgeons, and amputations the general rule. A method of using the antiseptic was soon adopted, and carried out in a series of cases with the most astonishing results: the injuries followed the same quiet course as if the skin had remained unbroken.

Lister first made his system of treatment known to Pasteur in the following letter which he wrote from Edinburgh to the French scientist on February 13, 1874.

"My dear Sir,

"Allow me to beg your acceptance of a pamphlet which I send by the same post, containing an account of some investigations into the subject which you have done so much to elucidate, the germ theory of fermentative changes. I flatter myself that you may read with some interest what I have written on the organism which you were the first to describe in your 'Memoire sur la fermentation appelée lactique.'

"I do not know whether the records of British surgery ever meet your eye. If so, you will have

seen, from time to time, notices of the antiseptic system of treatment, which I have been labouring for the last nine years to bring to perfection.

"Allow me to take this opportunity to tender you my most cordial thanks for having, by your brilliant researches, demonstrated to me the truth of the germ theory of putrefaction, and thus furnished me with the principle upon which alone the antiseptic system can be carried out. Should you at any time visit Edinburgh, it would, I believe, give you sincere gratification to see at our hospital how largely mankind is being benefited by your labours.

Lister writes to Pasteur

"I need hardly add that it would afford me the highest gratification to show you how greatly surgery is indebted to you.

"Forgive the freedom with which a common love of science inspires me, and

"Believe me, with profound respect,

"Yours very sincerely,

"JOSEPH LISTER."

The complete story of Lister's early experiments in the antiseptic treatment of wounds is best told in his own words, which we have extracted from an historic letter he wrote early in 1906 to Sir Hector Cameron:—

"In treating surgical cases antiseptically, I always endeavoured to avoid the direct action of the antiseptic substance upon the tissues, so far as was consistent in the existing state of knowledge with attaining the essential object of preventing the development of injurious microbes in the part concerned.

"In compound fracture, to which, in 1865, I first put in practice the antiseptic principle, I applied undiluted carbolic acid freely to the injured part in order to destroy the septic microbes already present in it; regarding the caustic action which I knew must occur as a matter of small moment compared with the tremendous evil which it was sought to avoid. But when this had once

Lister's account of his early experiments

been done no further direct action of the antiseptic upon the tissues occurred. The carbolic acid formed with the blood a dense chemical compound, which, together with some layers of lint steeped in the acid, produced a crust that adhered firmly to the wound and the adjacent part of the skin. This crust was left in place till all danger was over, its surface being painted from time to time with the acid, to guard against the penetration of septic change into its substance. Meanwhile in the undisturbed wound the beautiful result occurred that the material of the crust within it, and the portions of tissue which had been destroyed by the caustic, were replaced by living tissue formed at their expense.

"That dead tissue, when protected from external influences, was so disposed of, was a most important truth, new to pathology; and it afterwards suggested the idea of the catgut ligature.

"I do not remember whether you saw the case that led me to apply the antiseptic principle to abscess. The patient was a woman, above the middle period of life, with lumbar abscess. Taught by the disastrous results that sooner or later followed the evacuation of such abscesses, whether by valvular opening or by cannula and trocar, I left the case undisturbed, till one day, on looking at it, I found that nothing but epidermis seemed to intervene between the pus and the external world, so that if left for another day it would in all probability burst.

"I therefore resolved to open it, and apply a dressing which should imitate, as much as circumstances permitted, that which we used in compound fractures. The pus which escaped on incision was as thick as any I ever saw. Mixing some of it with undiluted carbolic acid, I applied some layers of lint, soaked with the mixture, to the wound and surrounding skin, and covered them with a piece of thin block tin, moulded to proper shape, such as we used for covering the crust in compound fracture. This metal covering, which prevented loss of carbolic acid by evaporation

and soaking into surrounding dressings, was fixed by strapping, and a folded towel was bandaged over it to absorb discharge.

"Next day, on changing the dressing, I was greatly astonished to see nothing escape from the incision except a drop or two of clear serum. What was now to be done? I had no longer any pus to mix with the carbolic acid. But it occurred to me that I might make a satisfactory crust by mixing carbolic acid with glazier's putty. Accordingly I sent to the dispensary for some whiting and boiled linseed oil, and making a solution of one part of carbolic acid in four of the oil, rubbed it up with whiting in a mortar, thus making a carbolic putty. This I spread on a piece of block tin and applied it as I had done the first dressing. There never was any further discharge of pus; the serous oozing diminished rapidly, and, before long, healing was complete.

"In that case, as there was no spinal curvature, I could not be sure that the abscess was connected with the vertebræ. But similar results afterwards followed the same treatment where discharge of bone showed that such connection existed, and also in suppuration of the hip joint, whether attended with shortening of the limb or not, scrupulous care being taken to keep the affected part completely at rest. The time required for final closing of the sinus was, however, generally much longer than in the first case.

"Precisely the same beautiful result, so entirely novel and so full of deep interest, both for pathology and practice, was seen when acute abscesses were treated in the same way, the only difference being that, in the acute cases, the serous oozing which followed evacuation of the pus came much more rapidly to a conclusion.

"In order to ensure freedom of escape for the serum, a narrow strip of lint soaked with a solution of carbolic acid in four parts of olive oil was inserted in the incision. But the antiseptic substance was never from first to last applied to the cavity of the

abscess, as such treatment could only have been productive of needless irritation.

"I continued to use a strip of lint as a drain for about five years, with perfectly satisfactory results. But in 1871, having opened a very deeply-seated acute abscess in the axilla, I found, to my surprise, on changing the dressing next day, that the withdrawal of the lint was followed by escape of thick pus like the original contents.

"It occurred to me that in that deep and narrow incision the lint, instead of serving as a drain, might have acted like a plug, and so reproduced the conditions present before evacuation. Taking a piece of the indiarubber tubing of a Richardson's spray producer that I had used for local anæsthesia at the operation, I cut holes in it and attached knotted silk threads to one end, so improvising a drainage tube. This I put to steep for the night in a strong watery solution of carbolic acid, and introduced it in place of the lint on changing the dressing next morning. The withdrawal of the lint had been followed by discharge of thick pus as before, but next morning I was rejoiced to find nothing escape unless it were a drop or so of clear serum. This rapidly diminished, and within a week of the opening of the abscess I was able to take leave of my patient, the discharge from thc abscess cavity having entirely ceased.

"After that case, I used drainage tubes, as a rule, in the treatment of abscesses. But it is well to remember that if such a tube should not be at hand, a narrow strip of lint—sterilised, of course, with some trustworthy antiseptic solution—will in almost every case answer the purpose equally well.

"The crude carbolic acid which, under the name of German creosote, was supplied to me by my colleague Dr. Anderson, Profcssor of Chemistry in the University of Glasgow, was a brown liquid which had been adulterated with water, and this lay on the top as a clear layer destitute of any flavour of carbolic acid. This led me in my first paper on compound fracture,

to speak of carbolic acid as absolutely insoluble in water. But when it was afterwards produced in a comparatively pure condition in colourless crystals, it proved to be capable of being taken up by water, though twenty parts were required for the purpose. The watery solution, however, though weak numerically, showed itself to be exceedingly potent as an antiseptic. Having applied it to a foul sore in the palm of the hand, I found on changing the dressing next day that all putrefactive odour had disappeared.

"This enabled me to use carbolic acid for washing wounds after operations, and so to extend the application of the antiseptic principle to surgery in general. In the state of knowledge at that early period, it seemed imperative to apply a powerful germicide to the wound before closing it. To use undiluted carbolic acid for operation wounds, as I had done in compound fracture, was out of the question; and carbolic oil, though I did indeed try it, was ill adapted for the purpose. But the watery solution could be satisfactorily used not only for washing the wound, but also for purifying the surrounding skin, the hands of the operator, and the instruments.

"The entire absence of carbolic acid in the layer of water on the 'German creosote' with which I made my first attempts with compound fractures, indicates that there were present in the crude product, substances for which the acid had incomparably greater attraction than it had for water. When purified from these substances, it is indeed soluble in water, but only in small amount; and being so feebly held by water it is free, when in watery solution, to act upon other matters for which it has stronger attraction. Thus was explained the remarkable germicidal energy of a lotion containing only a twentieth part of carbolic acid, as illustrated by the foul sore in the hand before referred to.

"With linseed oil, on the other hand, the acid could be mixed in any proportion, and, being firmly held by the oil, it was mild in action, though present in

the large proportion of 1 to 4, as used in the carbolic putty. The 1 to 4 carbolic oil is bland when applied to the tip of the tongue, whereas the 1 to 20 watery solution is intolerably pungent.

"The acid in the watery solution, while potent in action when applied, is soon dissipated, whereas it is slow in leaving the oil. Hence the watery solution, powerful but transient in operation, was admirably adapted for application to a cut surface as a detergent, while the carbolic putty, bland in action, and serving long as a store of the antiseptic, could be used with good effect not only for abscesses but also as an external dressing for operation wounds, and for that purpose I long employed it. The putty was used in a layer spread on calico, freely overlapping the skin around the wound and covered with a folded cloth to absorb the serum that flowed from beneath its edges. Although this mode of dressing gave place in time to others which were more convenient, the change effected under its use, at that early period, was of the most striking character; healing without suppuration, pain or fever, instead of being the rare exception, became the rule, and operations were safely performed which had previously been utterly prohibited on account of the danger that attended them; while pyæmia and hospital gangrene, which had before been disastrously rife, were banished from my wards.

"Epidermis is a substance for which carbolic acid has special attraction; and this, coupled with the facility with which the acid blends with oily matters, renders it peculiarly fitted for purifying the skin about the seat of operation and the surgeon's hands. Another property which aids its action as a detergent is its great penetrating power, not limited by the products of its chemical action upon organic substances.

"I used the 1 to 20 watery solution for rendering the patient's skin and the hands of myself and my assistants, aseptic, throughout the 40 years during which I practised on the antiseptic principle, and

I never had any reason to doubt its efficacy. No long time is required for its action. In my private practice, the purification of the skin was, as a rule, not begun till I entered the patient's room to perform the operation. The part concerned was then thoroughly washed with the 1 to 20 carbolic solution, and was kept covered with lint soaked with the same lotion, while the instruments were being attended to and the anæsthetic administered, the whole process occupying only about a quarter of an hour. Yet experience showed that this brief period was sufficient.

"It may, perhaps, be argued that under the carbolic putty, or any other dressing containing carbolic acid, that volatile agent was perpetually acting on the skin, and may have made up for deficiencies in the original purification. But during several years, before I gave up practice, the dressings did not owe their virtues to any volatile antiseptic.

"I cannot but think it a happy circumstance that the substance, which I employed first in endeavouring to apply the antiseptic principle, should have been so admirably adapted for detergent purposes. And it has grieved me to learn that many surgeons have been led to substitute, needlessly, protracted and complicated measures for means so simple and efficient.

"As an instance of trouble misapplied in this matter may be mentioned preliminary washing with soap and water. If carbolic acid is the disinfectant used, such washing is not only wholly unnecessary, but is, I believe, positively injurious, as it must tend to check the penetration of the germicide into the substance of the epidermis by saturating it with water for which carbolic acid has so little affinity. That this practice is superfluous is, I venture to think, proved by my experience, as I never in any case adopted it."

"While others," said Sir Hector Cameron, "had attempted by the use of carbolic acid and other antiseptics to lessen the discharge from suppurating surfaces, Lister taught that its beneficial influence,

as he employed it, was entirely due to its germicidal action and its consequent power against the sources of disturbance which existed in the dust of the surrounding air, and in such surfaces and objects as had come in contact with the air. He had long taught that wound inflammation and its consequences, were due to the chemical changes which occurred in the putrefaction of blood and serum, but only began to realise the character of the interaction of wounds without side agencies, after Pasteur had published his researches on fermentations in the early sixties."

The success of his experiments led Lister to apply his principles to a more extended field, and their application was attended with equally good results. Operations were performed with success, which formerly could have ended only in failure, and thus Lister developed his antiseptic system of treatment.

The success of Lister's methods

Antiseptic surgery cannot be said to have been heralded by a single brilliant discovery, but is a process that has developed slowly, step by step only, after careful experiment and long and patient research.

Lister's doctrines were received at first with the greatest scepticism and distrust by the profession. Sir James Simpson and others regarded the theory of atmospheric germs as "mythical fungi," while some compared them to a revival of the belief in the aerial sylphs and spirits of the Rosicrucian philosophers.

Sceptics of Listerism

Meanwhile, other investigators were pursuing experiments on Lister's principles, and at the meeting of the International Medical Congress in 1867, Bourgade suggested a method of dressing wounds after amputation, which he claimed to have employed with considerable success.

It consisted in well sponging and drying the wound, and covering it with pieces of lint dipped in a solution of chloride of iron. This was covered with dry lint, kept in place by adhesive strapping. The year following, Campbell de

Bourgade's method

Morgan advocated the use of chloride of zinc as a wound dressing, and employed it at the Middlesex Hospital. Among other substances also suggested and employed at this time were iron sulphate by Monsell, iodine and potassium permanganate by Duval, which were largely employed in America. Thymic acid was suggested by Paquet, Lewin, and Ranke, and salicylic acid by Lister, Thiersch, and others. A solution of chloral hydrate was stated to be remarkable for its prompt and healing powers as a dressing in case of serious wounds, and was largely employed for that purpose in Italy.

Lister appointed Professor of Clinical Surgery at King's College

In the early part of the year 1877, Lister was invited to take up the duties of professor of clinical surgery in King's College, London, and surgeon to the hospital. When he took up his residence in London he was still using carbolised gauze, the carbolic spray and oiled silk, but he was ever on the search for improvements, and aimed at the simplification of his methods and the avoidance or irritation of the wound by the processes employed. When corrosive sublimate was proved to be a more powerful antiseptic than carbolic acid he experimented with it largely, and ultimately suggested the dressing of gauze impregnated with the double cyanide of mercury and zinc, which is still so largely employed. Ultimately, when it was proved that the carbolic spray was ineffectual as a means of destroying the organisms in dust, Lister decided to abandon it, and thus the system of asepsis has now developed from Listerism. The results attending the surgeon's efforts to prevent the access of organisms to surgical wounds have been remarkable, and deaths from sepsis have been diminished to an extraordinary extent. Lister was probably the first to use a dressing sterilised by heat, and was the undoubted originator of many of the principles that have been adopted in modern surgery.

Referring to the advent of aseptic surgery, an amusing story is told of a veterinary surgeon in

Yorkshire, who practised over a century ago, and was famed throughout the countryside as a most successful operator. When asked as to his method of treatment, he always evaded the question with great astuteness, and would never give away the secret of his success. At length, when he grew to be a very old man, and became bowed down with age and weight of years, he was again implored by his son to tell him, before he died, what he did in the secret half-hour that he always gave himself before operating. Life was ebbing, when the old man at length whispered, with his passing breath, into his son's ear, "I biles my tools."

A pioneer in sterilisation

Thus, in ignorance and unconscious of the cause, he had achieved his success by the application of the principle on which aseptic surgery has since been based.

Lucas-Championnière once said that there were only two periods in surgery—that before Lister, and that since Lister, and all must admit, in considering the history of the subject, that the line indeed is very marked. Fifty years ago, the idea of a wound was inseparable from that of fever. At the private clinic of a famous surgeon in Germany, 80 per cent. of all wounds, he states, were attacked by hospital gangrene, and erysipelas after an operation was almost considered normal. When we compare this statement with the conditions that prevail at the present time, as instanced in our hospitals, some idea may be conceived of the line dividing these two periods. At the London Hospital, to-day, it is stated that 98 per cent. of the wounds in operations heal by first intention.

Before Lister, and since

Thus, in recapitulating the story of the immortal work done by Pasteur and Lister, it has been shown that the debt humanity owes to the two great minds which evolved the principles on which modern surgery is founded, is one that can never be repaid.